

The seal of the Office of the Special Inspector General for Iraq Reconstruction is a large, circular emblem. It features a central eagle with wings spread, holding an olive branch and arrows. The eagle is superimposed on a shield with vertical stripes. The seal is surrounded by text in both English and Arabic. The English text reads "INSPECTOR GENERAL" at the top and "IRAQ RECONSTRUCTION" at the bottom. The Arabic text reads "المفتش العام" at the top and "إعادة إعمار العراق" at the bottom.

**REVIEW OF MAJOR U.S. GOVERNMENT
INFRASTRUCTURE PROJECTS IN IRAQ:
NASSIRIYA AND IFRAZ
WATER TREATMENT PLANTS**

**SIGIR EV-10-002
OCTOBER 28, 2010**



SIGIR

Special Inspector General for IRAQ Reconstruction

October 28, 2010

Review of Major U.S. Government Infrastructure Projects in Iraq: Nassiriya and Ifrac Water Treatment Plants

Summary of Report: EV-10-002

Why SIGIR Did this Study

SIGIR is authorized to conduct oversight of the Iraq reconstruction program and to provide reports to the Secretaries of Defense, State, and the U.S. Congress.

The objectives of this evaluation were to determine the current operating status of the Nassiriya and Ifrac Water Treatment Plants (WTPs), the perceptions of Iraqi public officials and the local population regarding these projects, and the contribution of these projects to overall U.S. Government strategic goals. Costing a combined \$462 million, the Nassiriya and Ifrac WTP projects are two of the largest infrastructure projects funded by the U.S. Government in Iraq.

What SIGIR Recommends

SIGIR recommends that the Department of State and other U.S. Government agencies involved in stabilization and reconstruction operations that include major infrastructure projects:

1. Design useful measures of effectiveness tied to U.S. strategic goals and objectives for each program or project undertaken.
2. Identify baseline data prior to program or project implementation in order to fully measure program effectiveness and assess project outcomes and impact.
3. Develop plans to analyze current data against baseline data to determine any adjustments to program or project plans and budgets, prior to completion and transfer to local authorities.
4. Provide for the necessary training of and sustainment by local authorities, in order to realize medium and long-term strategic objectives.

Management Comments

U.S. Forces-Iraq reviewed the report and had no comments. SIGIR is working with State Department representatives who have indicated that they will shortly provide comments on the report and address the issues we have identified.

For more information, contact SIGIR Public Affairs at (703) 428-1100 or PublicAffairs@sigir.mil

What SIGIR Found

The U.S. Government (USG) defined its long term goal for Iraq as a “*peaceful, united, stable, democratic, and secure*” country. The USG authored three key documents, the Coalition Provisional Authority’s (CPA) Strategic Plan, *National Strategy for Victory in Iraq*, and *Counterinsurgency Field Manual*, which identified the provision of essential services to the Iraqi population as critical to stabilizing the population, improving security, and promoting democracy.

By the early 1990s, Iraq’s water sector was generally well developed and modern; however, by 2003, two wars, international sanctions, and mismanagement by the Saddam Hussein government resulted in its devastation. Iraq suffered from fast growing problems of malnutrition, morbidity, mortality of infants and under-five year old children, and water-borne illnesses.

In 2004, the CPA’s goal was to provide access to potable water to 90 percent of all Iraqis. The CPA funded two projects, in the amounts of \$277 million and \$185 million, to construct the Nassiriya and Ifrac WTPs. The CPA established output metrics for each WTP – to produce 10,000 cubic meters (m³)/hour and 6,000m³/hour of potable water to service 550,00 Thi-Qar residents and 600,000 Erbil residents. However, the lack of a comprehensive household water metering system in Iraq limited the ability to accurately determine the number of people serviced by either WTP.

In May 2010, SIGIR visited both WTPs and found the Nassiriya WTP producing water at 61 percent of its capacity, with higher than the maximum design amount of turbidity, and the Ifrac WTP near 100 percent of its capacity, with lower than the maximum design amount of turbidity. The Nassiriya WTP project managed by the Government of Iraq (GOI) continues to seek help from the USG, while the Kurdistan Regional Government (KRG) has taken actions independent of the USG for the operation and sustainment of the Ifrac WTP.

Due to the absence of baseline data to document conditions prior to the funding of these projects, SIGIR cannot conclusively determine whether either project had a measurable positive or negative impact. Based upon recent focus group and flash polling data of the local populations served by these projects, Thi-Qar residents hold an overwhelmingly negative view of the Nassiriya WTP project, the GOI, and the USG; however, a majority of Erbil residents hold a positive view of the Ifrac WTP project, the KRG, and the USG.

For the Nassiriya WTP, 23 percent of the local population is satisfied with water availability, 5 percent are satisfied with water quality, and 3 percent believe the USG provided significant or limited assistance in improving the area’s water supply. For the Ifrac WTP, 88 percent of the local population is satisfied with water availability, 85 percent are satisfied with water quality, and 43 percent believe the USG provided significant or limited assistance in improving the area’s water supply.

Dissatisfaction with the quality of the water of the Nassiriya WTP is so profound that only 14 percent use it as their main source of drinking water; the remaining 86 percent either purchase water or use water from rivers and streams. Focus group and flash polling data indicate that the Nassiriya WTP has not contributed to security or stability in Thi-Qar province.



SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

October 28, 2010

MEMORANDUM FOR U.S. SECRETARY OF STATE
U.S. AMBASSADOR TO IRAQ
U.S. SECRETARY OF DEFENSE
COMMANDING GENERAL, U.S. CENTRAL COMMAND
COMMANDING GENERAL, U.S. FORCES-IRAQ
ADMINISTRATOR, U.S. AGENCY FOR INTERNATIONAL
DEVELOPMENT
MISSION DIRECTOR-IRAQ, U.S. AGENCY FOR
INTERNATIONAL DEVELOPMENT

SUBJECT: Review of Major U.S. Government Funded Infrastructure Projects in Iraq:
Nassiriya and Ifrac Water Treatment Plants (SIGIR Report EV-10-002)

The Office of the Special Inspector General for Iraq Reconstruction (SIGIR) is providing this report for your information and use. The report discusses the current operating status of two water treatment plants, the perceptions of Iraqi public officials and the local populations served by the two plants, and the contributions of the two plants to overall U.S. Government strategic goals in Iraq. This evaluation was done to provide you and other interested parties with important information on the outcomes and impact of two major U.S. Government-funded infrastructure projects.

SIGIR received a response to a draft of this report from the United States Forces-Iraq. Its Engineering Capacity Development Office, in coordination with other appropriate staff of the United States Forces-Iraq, reviewed a draft of this report and had no comments. SIGIR is also working with State Department representatives who have indicated that they will shortly provide comments on the report and address the issues identified.

We appreciate the courtesies extended to our staff by U.S. Embassy-Baghdad, the Regional Reconstruction Team Erbil, the Provincial Reconstruction Team Thi-Qar, the United States Forces-Iraq, and the offices of the Gulf Region District of the U.S. Army Corps of Engineers. If you have any questions, please contact Mr. Philip J. Mistretta, Assistant Inspector General for Evaluations (Washington, D.C.) at 703-604-0527 or philip.mistretta@sigir.mil or Mr. Brian M. Flynn, Deputy Assistant Inspector General for Evaluations (Baghdad, Iraq) at 240-553-0581, extension 2485 or brian.flynn@sigir.mil.

A handwritten signature in black ink, appearing to read "Stuart W. Bowen, Jr.", written in a cursive style.

Stuart W. Bowen, Jr.
Special Inspector General

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Introduction

Objectives, Scope, and Methodology

The objectives of this evaluation were to determine the current operating status of the Nassiriya¹ and Ifrac² Water Treatment Plants (WTP), the perceptions of Iraqi public officials and the local population regarding these projects, and the contribution of each project to U.S. Government (USG) strategic goals. Costing approximately \$277 million and \$185 million, respectively, the Nassiriya and Ifrac WTPs are two of the largest infrastructure projects funded by the USG in Iraq.

Research for this study was undertaken by SIGIR staff from May 2010 to October 2010. This research was undertaken primarily in Iraq, including Nassiriya and Erbil, and was structured in five parts. SIGIR used the case study approach to assess the Nassiriya and Ifrac WTP projects, and the study was conducted in accordance with generally accepted principles for evaluations.

This study began with a literature review, which included international aid organizations' historical reports on the condition of Iraq, particularly the water and sanitation sector. In addition, SIGIR reviewed the limited Coalition Provisional Authority (CPA) documentation available regarding both WTPs. SIGIR's Inspection Directorate previously performed an assessment of the Nassiriya WTP; SIGIR reviewed this report to identify any construction and operational deficiencies noted. SIGIR conducted interviews during the second stage of the research, including interviews with officials from the U.S. Embassy in Baghdad, Iraq, the Iraq Strategic Partnership Office (ISPO),³ the U.S. Army Corps of Engineers, the U.S. Agency for International Development, and Provincial Reconstruction Team staff. These interviews took place in Baghdad, Nassiriya, and Erbil, and provided background on the USG's strategic goals and objectives, as well as information on each project. The third part of the research was conducted at the WTP locations in Nassiriya⁴ and Erbil. SIGIR performed site visits to each WTP, observed each facility, and spoke with WTP personnel responsible for the day-to-day operations and sustainment of each plant. The fourth part of the research consisted of interviews with local public officials in Nassiriya and Erbil. Specifically, SIGIR spoke with two Provincial Council members, a mayor, a governor, and senior officials within the Government of Iraq (GOI) and the Kurdistan Regional Government (KRG). The purpose was to solicit their views of each project, particularly the impact each project had on their communities and any problems they encountered operating and maintaining each facility. The final part of the research consisted of the utilization of focus group discussions and the conduct of flash polls of the local populations served by each WTP.

These two case studies evaluated the impact and effectiveness of the Nassiriya and Ifrac WTPs. Specifically, they explored the relationship between two particular large infrastructure projects in Iraq and the perceptions of the local population regarding these projects: Did providing potable water to these specific local populations result in winning their "hearts and minds"? If so, did it influence their attitudes toward the USG, the reconstruction effort in Iraq, and the GOI's ability to provide essential services in order to create a stable, democratic, and peaceful Iraq? SIGIR examined the widely held assumption that infrastructure and essential services development projects promote security and stability, and the effectiveness of using development project assistance as part of an overall counterinsurgency strategy.

¹ The "Nassiriya WTP" services five cities (Shatra, Diwayah, Garaff, Nassiriya, and Suq Al Shoyokh) within three districts of Thi-Qar Province, Iraq.

² The "Ifrac WTP" is located near the city of Erbil in Erbil Province, Iraq.

³ The ISPO is the successor organization to the Iraq Transition Assistance Office. ISPO was created by executive order on 10 May 2010.

⁴ The physical location of the Nassiriya WTP is in Shatra district of Thi-Qar Province.

Background

Initial and Revised Strategic Goals in Iraq

In 2003, the USG's military and foreign policy objectives entailed immediate, medium, and long-term goals with respect to Iraq. The military objective and immediate goal was to end the regime of Saddam Hussein, locate and eliminate Iraq's weapons of mass destruction, and identify and capture or kill all internal terrorists.⁵ The foreign policy objective and medium range goal consisted of establishing a stable, democratic Iraq;⁶ while the long-term goal was that a democratic Iraq would unleash a tidal wave of democracy throughout the Middle East.⁷ Specifically, the President believed that as *"Iraq[i] democracy succeeds, that success is sending a message from Beirut to Tehran that freedom can be the future of every nation. The establishment of a free Iraq at the heart of the Middle East will be a crushing defeat to the forces of tyranny and terror."*⁸

The goal of establishing a functioning democracy within Iraq addressed what the U.S. Administration believed were the root causes of Muslim extremism. Specifically, terrorists generally draw recruits from disaffected youths, who live under totalitarian rule and have few prospects for gainful employment and no hope of improving their position in society.⁹ In its view, the world had *"a clear interest in the spread of democratic values, because stable and free nations do not breed the ideologies of murder. They encourage the peaceful pursuit of a better life. And there are hopeful signs of a desire for freedom in the Middle East."*¹⁰

Members of the U.S. Congress believed that the achievement of stability and democracy in Iraq presented an opportunity to catalyze change in the region that would greatly improve U.S. national security. Stabilizing and reconstructing Iraq were the keys to success in this larger context of the Middle East region and in the global war on terrorism.¹¹

The original pre-war reconstruction planning called for repairing only what the invasion had destroyed. However, this planning did not envision the full extent of the failure of Iraq's infrastructure, especially the electrical, water, health, and education systems. The Coalition attempted to protect Iraq's people and infrastructure during its bombing and ground combat campaigns to remove Saddam Hussein from power; consequently, Iraq's infrastructure had been relatively unaffected by the war. Yet, by June 2003, U.S. officials found the dilapidated condition of Iraq's critical infrastructure badly run down from years of mismanagement, wars, economic sanctions, and the widespread looting that followed Saddam Hussein's fall. Estimates by various U.S. agencies and international organizations projected the cost to rebuild Iraq's infrastructure at approximately \$60 billion. Not only was this number significantly higher than ever anticipated, it also dashed the USG's initial plans that Iraq's oil revenues would finance the

⁵ "News Transcript from the United States Department of Defense; DoD News Briefing, Secretary of Defense Donald H. Rumsfeld," M2 Presswire, 24 March 2003, Normans Media Ltd., <<http://www.highbeam.com/doc/1G1-99122277.html>>

⁶ "Coalition Provisional Authority, Baghdad, Iraq: Achieving the Vision to Restore Full Sovereignty to the Iraqi People (Strategic Plan)," 1 October 2003.

⁷ Marina Ottaway, Thomas Carothers, Amy Hawthorne, and Daniel Brumberg, "Democratic Mirage in the Middle East," Carnegie Endowment for International Peace, Policy Brief, 20 October 2002, <<http://www.ceip.org>>.

⁸ "President Discusses War on Terror at Fort Hood," The White House President George W. Bush, ed. Office of the Press Secretary, 12 April 2005, The White House, <<http://georgewbush-whitehouse.archives.gov/news/releases/2005/04/20050412.html>>

⁹ Todd Keister, "When War Is Not a War? Defining and Achieving Victory in Iraq," American Diplomacy.org, 29 January 2008, American Diplomacy, <http://www.unc.edu/depts/diplomat/item/2008/0103/keis/keister_whenis.html>.

¹⁰ "President Discusses the Future of Iraq," The White House President George W. Bush, ed. Office of the Press Secretary, 26 February 2003, The White House, <<http://georgewbush-whitehouse.archives.gov/news/releases/2003/02/20030226-11.html>>

¹¹ United States Senate, 108th Congress, 1st Session. "Iraq Stabilization and Reconstruction: U.S. Policy and Plans," U.S. Government Printing Office, 22 May 2003, <<http://www.gpo.gov/fdsys/pkg/CHRG-108shrg132/pdf/CHRG-108shrg132.pdf>>

majority of post-Saddam Iraq's reconstruction.¹² It soon became evident that a much more encompassing reconstruction program, funded primarily by the USG, would be necessary.

CPA Strategic Plan for Iraq

In October 2003, the CPA, which initially oversaw the reconstruction of Iraq, drafted its strategic plan, *Achieving the Vision to Restore Full Sovereignty to the Iraqi People*. The CPA's strategic plan identified the "primary goal" of a "unified and stable, democratic Iraq." The CPA's strategy for achieving this goal consisted of four "core foundations," including security, essential services, economy, and governance. The foundation of essential services was the "effective delivery of basic services... for the Iraqi people." The effective delivery of essential services vaguely referenced "improving water resource management" without articulating whether it meant improving existing water supply, increasing access to potable water, or developing the laws, regulations, and institutions required to manage water resources.

The original pre-war planning assumed the Iraqi population would view the U.S. as "liberators" rather than "occupiers." The initial widespread looting and lawlessness that ensued after the collapse of the Saddam Hussein regime surprised U.S. planners. This instability not only threatened Iraq's future as a secure, democratic, and prosperous nation; the levels of violence endangered the stability of Iraq's neighbors as well. Consequently, the USG took the position that stabilizing and reconstructing Iraq became the keys to providing an environment in which democracy would flourish. As a result, the CPA defined its mission as working with the Iraqi people and an interim Iraqi administration to "establish the condition for a free, sovereign, democratically-elected representative government."¹³

Strategic Goals and Infrastructure Projects

In November 2005, the National Security Council published the "*National Strategy for Victory in Iraq*," which "articulates the broad strategy the President set forth in 2003 and provides an update on our progress as well as the challenges remaining." The *National Strategy for Victory in Iraq* stated that the "ultimate victory will be achieved in stages," which it identified as "short term," "medium term," and "longer term." The *National Strategy for Victory in Iraq* presented a "comprehensive" strategy, which included "three integrated tracks—political, security, and economic—each with separate objectives."

The *National Strategy for Victory in Iraq* specifically broke down the political/security/economic strategy into eight pillars or strategic objectives. Strategic objective number four was to "help Iraq Build Government Capacity and Provide Essential Services." The "Economic Track" objective was to "assist the Iraqi government in establishing the foundations for a sound economy with the capacity to deliver essential services." To achieve this objective, the *National Strategy for Victory in Iraq* required the USG to "restore Iraq's neglected infrastructure so it can meet increasing demand and the needs of a growing economy" and "build the capacity of Iraqi institutions to maintain infrastructure...and improve the general welfare of all Iraqis."

This document addressed the underlying root causes of the growing insurgency—an unstable Iraq and the lack of confidence in the GOI due to its inability to provide basic essential services to its citizens. Iraq's essential services infrastructure suffered under the previous regime, which left the Iraqi population in need of water, electricity, and health care facilities. In

¹² Special Inspector General for Iraq Reconstruction, *Hard Lessons: the Iraq Reconstruction Experience*, (Washington, D.C., 2009).

¹³ Coalition Provisional Authority, Baghdad, Iraq: "Achieving the Vision to Restore Full Sovereignty to the Iraqi People (Strategic Plan)," 1 October 2003.

November 2003, the USG appropriated \$18.4 billion for the reconstruction of Iraq's infrastructure to assist with, among other things, the provision of essential services.¹⁴

According to the *National Strategy for Victory in Iraq*:

*The rebuilding of Iraq's infrastructure and the provision of essential services will **increase the confidence of Iraqis** in their government and help convince them that the government is offering them a brighter future. People will then be more likely to cooperate with the government, and provide intelligence against the enemy, creating a less hospitable environment for the terrorists and insurgents.*

According to this document, the strategic objective of assisting the Iraqi government with providing essential services to its citizens included rehabilitating "water and sanitation infrastructure to provide safe drinking water and reducing the transmission of water-borne disease."

The *National Strategy for Victory in Iraq* also stated that there are "numerous indicators to map the progress of our strategy and change our tactics whenever necessary"—specifically, reports issued weekly, monthly, and quarterly by agencies and military units. These reports contain "detailed metrics," including information such as gross domestic product (GDP), per capita GDP, inflation, electricity generated and delivered, barrels of oil produced and exported, and numbers of businesses opened. "Other indicators are also important to success, but less subject to precise measurement, such as the...trust in government institutions...taking hold amongst a population that has never known them."

By 2005, the swelling insurgency, comprised of former Ba'athists, Sunni Arabs, al-Qaeda, militias, and criminal gangs,¹⁵ continued to hinder the USG's attempts to stabilize and reconstruct Iraq. The insurgency hampered the attempts to create a democracy by targeting Coalition forces, the Iraqi government and its security forces personnel, and any Iraqi civilians working with the Coalition forces; while attempts to reconstruct Iraq's infrastructure were met with daily attacks, assassination attempts, and a wave of bombings.¹⁶ Conventional wisdom held that the original members of the insurgency consisted of Ba'athists, terrorists, and militias;¹⁷ however, by 2005, new recruits came from the large number of unemployed, young males throughout Iraq and disenfranchised Iraqis¹⁸ who blamed the U.S. and Iraqi governments for sewage flowing in the streets, brackish water from the household tap, and frequent power outages.¹⁹ As the violence increased in scope, complexity, and lethality,²⁰ the insurgency created an environment of fear within Iraq²¹—fear of joining the Iraqi security forces, fear of cooperating with the Coalition, and fear of venturing out into the streets.

¹⁴ U.S. Public Law 108-106, 108th Congress, 6 November 2003. "Other Bilateral Economic Assistance Funds Appropriated to the President Iraq Relief and Reconstruction Fund."

¹⁵ U.S. Senate, Senate Armed Services Committee. "The Current Situation in Iraq and Afghanistan," *Defense Intelligence Agency*, 15 November 2006. < <http://www.dia.mil/public-affairs/testimonies/2006-11-15.html>>.

¹⁶ Special Inspector General for Iraq Reconstruction, *Hard Lessons: the Iraq Reconstruction Experience*, (Washington, D.C., 2009).

¹⁷ DoD Report to Congress, "Measuring Stability and Security in Iraq," 13 October 2005
<<http://www.defense.gov/news/jul2005/d20050721secstab.pdf>>.

¹⁸ The Senlis Council, *Security and Development Policy Group*, London, "Iraq: Angry Hearts and Angry Minds," June 2008
<http://www.icosgroup.net/documents/iraq_angry_hearts.pdf>.

¹⁹ James Bennet, "The Mystery of the Insurgency," *New York Times*, 15 May 2005.

²⁰ U.S. Senate, Senate Armed Services Committee. "The Current Situation in Iraq and Afghanistan," *Defense Intelligence Agency*, 15 November 2006, < <http://www.dia.mil/public-affairs/testimonies/2006-11-15.html>>.

²¹ Steven Metz, "Learning from Iraq: Counterinsurgency in American Strategy," *Strategic Studies Institute*, January 2007, < <http://www.strategicstudiesinstitute.army.mil/pdffiles/pub752.pdf>>.

Counterinsurgency Field Manual

On February 22, 2006, al-Qaeda terrorists in Samarra bombed the al-Askari Mosque, one of the holiest sites in Shia Islam, destroying its golden dome and severely damaging the mosque. Desecrating the gravesite of the Tenth and Eleventh Imams was a psychic blow to Iraq's Shia population and accelerated the pace of sectarian killing that had been rising steadily for months. At least 1,300 Iraqis, mostly Sunni, were murdered in the next four days, many slain in the streets by organized killing squads associated with the militia of Muqtada al-Sadr.

In December 2006, at the height of the violence, the Department of the Army released the new *Counterinsurgency (COIN) Field Manual (FM)*²² to establish doctrine for military operations in a COIN environment. COIN FM is based on lessons learned from previous counterinsurgencies and contemporary operations. COIN refers to military, paramilitary, political, economic, psychological, and civic actions taken by governments or occupying forces to quash a rebellion. The COIN FM argues that most active, passive, and potential supporters of an insurgency (whether they are ideological, ethnic, or religious in nature) can be won over through the provision of security, since “*citizens seek to ally with groups that can guarantee their safety.*” Specifically, the COIN FM states that “during any period of instability, people’s primary interest is physical security for themselves and their families. When HN [host nation] forces fail to provide security or threaten the security of civilians, the population is likely to seek security guarantees from insurgents, militias, or other armed groups. This situation can feed support for an insurgency. However, when HN forces provide physical security, people are more likely to support the government.”

“Hearts and Minds”

Winning “hearts and minds” refers to a “clear understanding that military force is useful only in conjunction with a policy of economic and political development that attacks the causes of unrest.”²³ However, the origins of the phrase “hearts and minds” can be traced back to the second President of the United States, John Adams, who stated:

*The [American] Revolution was effected before the War commenced. The Revolution was in the minds and hearts of the people; a change in their religious sentiments of their duties and obligations. This radical change in the principles, opinions, sentiments, and affections of the people, was the real American Revolution.*²⁴

The COIN FM embraced the model of “winning hearts and minds” stating:

This is the true meaning of the phrase ‘hearts and minds,’ which comprises two separate components. ‘Hearts’ means persuading people that their best interests are served by COIN success. ‘Minds’ means convincing them that the force can protect them and that resisting it is pointless. Note that neither concerns whether people like Soldiers and Marines. Calculated self-interest, not emotion, is what counts. Over time, successful trusted networks grow like roots into the populace. They displace enemy networks, which forces enemies into the open, letting military forces seize the initiative and destroy the insurgents.

²² Generals David H. Petraeus, and James F. Amos, *Counterinsurgency Field Manual 3-24*, (Washington, D.C.: Department of the Army, 15 December 2006) vii.

²³ Thomas Mockaitis, “The Origins of British Counterinsurgency,” *Small Wars and Insurgencies* 1/3, December 1990.

²⁴ Dixon, Paul, “‘Hearts and Minds’ British Counter-Insurgency from Malaya to Iraq,” *Journal of Strategic Studies*, Vol. 32, Issue 3, 3 June 2009.

COIN, Essential Services, and Infrastructure Projects

The *National Strategy for Victory in Iraq* defined the long-term stage of Iraq as a nation that is “peaceful, united, stable, democratic, and secure.” This document stated that rebuilding Iraq’s infrastructure to provide essential services will increase the confidence of Iraqis in their own government. One specific essential service mentioned for rehabilitation was the water and sanitation sector, in order to reduce the transmission of water-borne disease. The National Strategy for Victory in Iraq identified the “strategic” significance of “detailed metrics” for the Economic Track; yet, this document did not suggest measuring the mood of the Iraqi people to determine if the completed reconstruction projects were actually winning “hearts and minds” and increasing the confidence of Iraqis in their government.

The COIN FM identified the Iraqi local population as key to the success of a stable and democratic Iraq. In order to influence the local population, the COIN FM stresses the importance of meeting its essential services needs. Specifically, essential services “provide those things needed to sustain life. Stabilizing a population requires meeting these needs. People pursue essential needs until they are met, at any cost and from any source. People support the source that meets their needs. If it is an insurgent source, the population is likely to support the insurgency. If the HN government provides reliable essential services, the population is more likely to support it.”

With respect to essential services, the COIN approach called for the USG to initially take the lead in constructing new infrastructure and providing mentoring and assistance with operating the facilities. However, the GOI was to be responsible for long-term operation and sustainment of the facilities with little or no assistance from the USG. The U.S. administration’s strategy was that, “as the Iraqis stand up, we will stand down.”²⁵ This initially referred to the Iraqi security forces (that is, as the Iraqi security forces increase, the number of U.S. forces will decrease), but the sentiment also applies with respect to the USG’s capacity building efforts.

The USG would take the lead by funding, constructing, and initially operating and maintaining major infrastructure projects, such as water treatment plants capable of producing potable water. However, over time, the USG’s role would transition to training and mentoring their GOI counterparts on the operation and maintenance of the infrastructure projects. As the GOI’s skills and capabilities increased, there would be less reliance upon the USG. Therefore, the “goal” would be a fully self sufficient GOI able to meet the needs of its citizens without assistance from the USG.

Further, “hearts and minds” activities seek to change the perceptions of the local population to overcome any ill-founded or negative assumptions they might hold about the USG and its military forces; while also changing local perceptions about their own government.²⁶ The underlying assumption of “hearts and minds” activities is that, for example, an adequately constructed and successfully operated infrastructure project providing essential services, such as potable water, to the local population would yield positive returns to both the U.S. and Iraqi governments. The COIN doctrine suggests that the local population would recognize the USG for responding to their dire needs with an infrastructure project and appreciate the ability of the Iraqi government to provide essential services through the successful operation of the facility. This would increase the confidence the local population has in its own government and help convince them the government offers a brighter future. The COIN FM then predicts that the “satisfied” local population will reject the insurgency and become enthusiastic supporters of the national government.

²⁵ “President Discusses Iraq War at Fort Hood,” President George W. Bush Address to the Troops, 28 June 2005.

²⁶ Mark Bradbury and Michael Kleinman, “Winning Hearts and Minds? Examining the Relationship Between Aid and Security in Kenya,” *Feinstein International Center*, (Medford: Tufts University, April 2010).

Yet, in Iraq, a critical lack of monitoring, evaluation, and empirical data has made it difficult to assess the impact “hearts and minds” projects have on the local population.

Reconstruction of the Water Sector in Iraq

Euphrates River

The Euphrates River is the source of water for the Nassiriya WTP. It begins in Turkey and flows through Syria before joining the Tigris River in Iraq to form the Shatt-al-Arab river. As the longest river in the Middle East, the Euphrates River originates in the eastern highlands of Turkey, between Lake Van and the Black Sea, and travels approximately 2,700 kilometers (km) before flowing into the Persian Gulf. Approximately 40% of the river lies within Turkey; while the remainder is divided between the two downstream countries, Syria (25%) and Iraq (35%). The Euphrates drains an area of approximately 444,000 square kilometers (km²); yet while less than 30% of the river’s drainage basin is in Turkey, roughly 94% of the river’s water comes from the Turkish uplands. The Euphrates River produces a mean annual flow of approximately 30 billion cubic meters (m³) at its entrance to Syria, which rises to about 32 billion m³ at the Syrian-Iraqi border after gaining the inputs from two Syrian tributaries, the Balikh and the Khabur.²⁷

Over the centuries, a majority of Iraq’s population has continued to live near a permanent water source, which includes the Euphrates, Tigris, and other rivers, natural and artificial lakes, and open irrigation channels supplied from existing dams.

Potable Water in Iraq: Mid-1970s to 1991

From the mid-1970s to the mid-1980s, the GOI invested a part of its oil revenues to provide fully subsidized social services, such as water, sanitation, health, and electricity, to all its citizens, without any discrimination.²⁸ In the late 1970s through the 1980s, the then-Saddam-ruled GOI embarked on an ambitious modernization plan developing large urban and rural water supply systems primarily depending upon surface water. A vibrant oil-based economy and modern aspirations spurred the water-sector growth with adequate funding and political support. Even though one of the devastating effects of the eight year Iran-Iraq war was a significant decrease in social-sector spending, by the 1980s, the water and sanitation sector received an average annual budget allocation equivalent to US \$100 million, which was used to cover staff salaries and operation and maintenance costs. The sector boasted strong management and more than 5,000 staff members, including 1,100 administrators, 350 engineers, 1,400 operators, 500 technicians, and 1,700 unskilled laborers.

By the early 1990s, Iraq’s water sector was well developed and modern, equipped with sophisticated western designed and dependent technologies, such as conventional WTPs and compact units (CUs). Over 90% of all treated water came from Iraq’s 226 WTPs and 900 CUs, respectively. Iraq’s remaining water supply came from over 200 deep borehole wells (primarily in northern Iraq), five dams (with a design storage capacity of 82.5 cubic kilometers (km³)), and other storage devices, such as artificial desert lakes and earth dams, which accounted for 90 km³ of water storage. Iraq’s water sector relied heavily on foreign experts for all major infrastructure development and routine maintenance and repair of all existing equipment and WTPs. With state-of-the art technology and foreign experts operating and maintaining the equipment, the water sector enjoyed high levels of efficiency. Urban access to drinkable water was at 95% with an average of 330 liters per person per day (lppd) in Baghdad, and 250-300 lppd in other cities

²⁷ Ali Akanda, Sarah Freeman, and Maria Placht, “The Tigris-Euphrates River Basin: Mediating a Path Towards Regional Water Stability,” *Al Nakhlah*, (Tufts University) Spring 2007 < http://fletcher.tufts.edu/al_nakhlah/archives/spring2007/placht-2.pdf >.

²⁸ Sen, Biswajit, “Iraq Watching Briefs – Overview Report,” UNICEF, July 2003

and towns. Even rural area coverage was approximately 75% with an average supply of 180 lppd. Public health indicators confirmed the quantity and quality of the water with minimal water and sanitation related diseases.²⁹

Effects of the 1991 Gulf War and International Sanctions on Iraq's Water Supply: 1991 to 2003

The 1991 Gulf War and subsequent international sanctions significantly affected Iraq's water sector.³⁰ The U.S. military's bombing missions in 1991 targeted Iraq's national grid, which resulted in Iraq experiencing electrical power cuts anywhere from 70% to 96%. Iraq's water treatment technologies were heavily dependent upon electrical power; consequently, the WTP operators, desperate for power to run the facilities, utilized standby generators as prime power sources, even though the generators were not designed for this purpose. As a result, water production immediately fell by 40%. The government attempted to construct electrical power lines dedicated to critical WTPs in larger cities; however, the period between 1991 and 1995 witnessed a 90% fall in the government's budgets, which significantly reduced the number of power lines actually constructed. When the government could afford to make emergency repairs of the grid or construct power lines, it often had disastrous consequences. Poor coordination of repair work and new power line construction to the WTPs resulted in power being restored without any notice; the ensuing power surges, overloading, and fluctuations damaged sophisticated equipment, such as motors and automotive control mechanisms, which are critical to the efficient operation of the WTPs.

In addition, during the war, the water sector experienced significant personnel losses from foreign experts who fled Iraq. Specifically, 55% of the water sector staff, primarily high-level managers, experienced engineers, and high-level operations and maintenance staff left the country and the positions were never filled.³¹

Further, the fast-growing Iraqi population far exceeded the capacity of the water system to deliver potable water. Between 1991 and 1996, the population of Baghdad alone increased by 500,000 people; yet the capacity of the water service actually declined. The aging and rapidly deteriorating technologies were not designed to meet the increased demand or last for an extended period of time. Also, international sanctions curtailed Iraq's ability to purchase critical spare parts, treatment chemicals, and reagents—all required to provide safe water supply services.

The United Nations (UN) Security Council, on April 14, 1995, passed Resolution 986 establishing the Oil for Food Program (OFFP), which was designed to temporarily provide essential humanitarian aid to the Iraqi people. A main component of the OFFP was to alleviate the serious nutritional and health problems developing within Iraq. By late 1997, water sector supplies started to trickle into Iraq. Between 1996 and 2003, approximately US \$3 billion was allocated to the water and sanitation sector, with approximately US \$1.1 billion worth of spare parts and equipment arriving by December 2002. However, the effectiveness of the OFFP was severely handicapped due to the lack of a "cash component" necessarily for critical capacity development needs and for paying local contractors to perform civil, electrical, and mechanical work. While the OFFP provided some immediate relief including several noteworthy achievements in the water sector, the funding covered only about 25% of what was actually needed to restore the water system to acceptable operational standards. In addition, initial priority was given to water production at the expense of water quality.

²⁹ Doyle, Brendan, "Iraq Watching Briefs – Water and Environmental Sanitation," UNICEF, July 2003.

³⁰ Carel DeRooy, "United Nations/World Bank Joint Iraq Needs Assessment – Water and Sanitation," October 2003, The World Bank, <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/05/06/000160016_20050506165619/Rendered/PDF/315410IQ0WATER01public1.pdf>.

³¹ Doyle, Brendan, "Iraq Watching Briefs – Water and Environmental Sanitation," UNICEF, July 2003.

The cumulative effect of the entire situation was the water sector in a state of collapse and barely able to keep functioning during the post-Gulf War period, with much of this achieved through the cannibalization of parts from less critical equipment, for use in other more crucial areas. It was estimated that 70% of the country's water distribution networks, amounting to 40,000 km of pipes and valves, required replacement because of severe corrosion, damage, or old age. The estimated efficiency of the existing drinking water production facilities ranged between 40% and 60% of the design capacity, with water losses amounting to 50% of all water produced. In addition:³²

- Urban access to potable water fell from 95% to 92%; however, quantities of water in Baghdad fell from 330 lppd to 218 lppd and in other cities and towns from 250 lppd to 171 lppd
- Rural access to potable water fell from 75% to 30%, and quantities of water fell from 180 lppd to 91 lppd
- Water losses from old age and corrosion of pipes and illegal tapping rose to 60%

The resulting insufficient access to safe water is a key underlying cause of diseases and malnutrition in Iraq. Diarrhea, which is directly linked to unsafe drinking water and poor hygienic practices, is prevalent in developing countries around the world and the second leading cause of death of under-five year old children. Between 1990 and 1996, Iraq suffered from a tremendous increase in children's diarrhea morbidity³³—from 3.8 episodes per child/year to 15 episodes per child/year. Iraq's infant death rate from diarrhea was higher than the world average. Diarrhea also has a severely negative impact on pregnant women by impeding their ability to optimally absorb protein and energy from food, which contributes to malnutrition during pregnancy and resulting low birth-weight babies. In 1996, 4.5% of Iraqi children born weighed less than 2.5 kilograms (kg) (5.5 pounds (lb)); unofficial reports from the Ministry of Health indicate that 25% of children born in 1999 weighed less than 2.5kg. Compounding the problem was a dramatic drop of Iraqi women breastfeeding their children in favor of infant formula. In the 1980s, approximately 90% of Iraqi women breastfed their children; however, by 1997, only 13% were breastfeeding. In fact, by 1997, powdered infant formula and milk³⁴ became essential components of the Iraqi Public Distribution System, the largest public food program operating in the world. However, both powdered infant formula and milk require "safe" water for proper utilization; yet, Iraqi mothers had to rely upon unsafe water in the preparation of baby food (that is, for washing bottles and mixing with the infant formula), which exposed their children to diseases, such as diarrhea.

As a result, Iraq suffered from a fast-growing problem of malnutrition, morbidity, and mortality of infants and under-five year old children. Children's health and nutrition suffered greatly during the 1991 to 1996 period. Specifically:

- Deaths of under five-year olds from diarrhea rose from 21% before the war to 38% during and following the war
- A three-fold increase in mortality among five-year old children (an estimated excess of approximately 47,000 children died between January and August 1991)
- Acute children's malnutrition rose from 3% to 11%
- Children's underweight prevalence rose from 9% to 23%
- Chronic malnutrition (stunting) rose from 19% to 32%

The dramatic rise in mortality rates of under-five-year-old children after 1984 paints a graphic picture of the negative impact unsafe water, poor sanitation, and unsanitary living conditions had

³² Doyle, Brendan, "Iraq Watching Briefs – Water and Environmental Sanitation," UNICEF, July 2003.

³³ Morbidity refers to a diseased state, disability, or poor health due to any cause.

³⁴ Powdered milk is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it. Milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low moisture content. Due Iraq's unreliable electricity, the Government of Iraq favored utilizing powdered infant formula and milk as staples of the Public Distribution System.

on Iraqi children's survival and development. For example, under-five mortality rates per 1,000 live births:

- Rose from 56 to 92
- Increased from 92 to 131 by 2000, with five of Iraq's 18 provinces exceeding 140

In addition, infant mortality rates between 1984 and 1999 rose from 47 to 108.

Further, damage to the water and sanitation sector resulted in the following:³⁵

- Typhoid fever cases increased eightfold to 15,238
- Giardiasis³⁶ rose sixfold to 584,621
- Malaria cases rose from 870 (in 1995) to 16,296 (in 1996) in northern Iraq alone

Impact of the 2003 Gulf War

Even with the benefits of the OFFP, the water sector, by March 2003, experienced a steady but devastating decline from the previous two decades. Even though the GOI reported that access to safe water supply in Baghdad had fallen by only 3% (from 95% to 92%) between 1991 and 2002 (or from 330 lppd to 218 lppd), this did not capture the reality of the situation. The majority of Iraqi people did not enjoy this amount of water anywhere, especially those at the end of leaking and damaged water distribution networks. In many areas of the country, water flowed, if at all, for only a few hours each day; damaged and leaking pipes, along with illegal taps into the distribution networks, resulted in low pressures and significantly increased risk of contamination from raw sewage and other pathogens seeping into the leaking system. In addition, Iraq did not have the ability to detect contaminants within the water network. In 2000, the United Nations Children's Fund (UNICEF) visited 18 water treatment sites and found only eight equipped with a laboratory. However, each laboratory's capabilities were rudimentary; basic analyses such as potential of pH,³⁷ alkalinity, and hardness, which do not require sophisticated equipment, were performed. Some laboratories were equipped to perform jar tests that are of little use in the case of inaccurate dosing of coagulants and poor flocculation. UNICEF doubted the "effectiveness" of water treatment at the sites it visited throughout Iraq.

All told, Iraq's water distribution networks, suffering from badly leaking pipes and countless illegal taps, simply could not cope with aging infrastructure and the growing demand of an ever-increasing population. By 2003, potable water quantities, which were not always "safe," were limited to those populations living close to the production side (that is, WTPs and booster pumps); while those living outside the area, which was a substantial portion of the Iraqi population, received significantly less. It was estimated that those fortunate enough to live near the production side in Baghdad received 150 lppd; while, those outside received as little as 65 lppd.

Initial reports indicated that the impact of the 2003 Gulf War resulted in almost half of all water and sewage treatment and pumping stations being put out of commission due to acute power cuts, looting, and collateral war related damage. Unreliable electrical power, old and poorly maintained generators, and severe fuel shortages resulted in a more than 50% reduction of operational time for water treatment and distribution. It was estimated that as much as \$500 million worth of vital water and sewer sector equipment, spare parts, water treatment chemicals, and vehicles were looted out of plants, stations, and warehouses immediately after the start of the war.³⁸ In addition, while Coalition war plans tried to avert the destruction of essential

³⁵ Doyle, Brendan, "Iraq Watching Briefs – Water and Environmental Sanitation," UNICEF, July 2003.

³⁶ Also known as "beaver fever," it is a diarrheal infection of the small intestine by a single-celled organism called *Giardia lamblia*. According to Giardiasis.org, Giardiasis occurs worldwide with a prevalence of 20-30% in developing countries.

³⁷ The acidity (or basicity) of a solution is measured using the pH scale.

³⁸ Sen, Biswajit, "Iraq Watching Briefs – Overview Report," UNICEF, July 2003

services infrastructure, vibrations from heavy bombing and tank movement throughout the country disrupted the already fragile water distribution network system. Access to safe water fell to approximately half of the already low pre-war quantities in Baghdad and throughout cities and rural areas in Iraq. In addition, it was estimated that more than 1 million m³ of raw sewage was discharged daily into rivers or city streets. Without operating WTPs, this sewage ultimately made its way into the distribution network and into Iraqi homes fortunate enough to receive any water at all.

Rehabilitating Iraq's Water Sector

As mentioned earlier, by 2003, the international community witnessed the depth of the collapse of Iraq's water sector. Unreliable electrical power, widespread looting of WTPs and warehouses of essential equipment and chemicals, and war damage completely overwhelmed a water sector already in shambles from decades of sanctions and under-investment. Acute water shortages and significant increases in water-borne and sanitation related diseases resulted in significantly increased morbidity, malnutrition, and mortality rates; in some cases double the pre-war figures.³⁹

The *National Strategy for Victory in Iraq* and COIN FM identified the provision of essential services, such as potable water, as critical to the overall security and stability of Iraq. The end goal of both documents was to efficiently provide essential services in an effort to win the "hearts and minds" of the local population and increase the confidence of Iraqis in their government. The CPA, which initially oversaw the reconstruction of Iraq, recognized that rehabilitating Iraq's water sector offered one of the greatest opportunities for development impact in the post-conflict environment. Providing "safe" drinking water to a desperately thirsty nation, in fact, had more than just a development impact; it presented an opportunity to influence the opinion and beliefs of the Iraqi population toward the Coalition and the USG. The majority of the Iraqi population initially welcomed the United States as "liberators;" however, that attitude drastically changed when the CPA and the interim Iraqi government were unable to provide essential services, leaving Iraqis with no water during scorching summer temperatures. The growing insurgency, pouncing on the increasing level of unhappiness as a recruiting tool, actively courted this group to reject the Coalition and the interim Iraqi government. This posed potentially lethal consequences to Coalition members and local Iraqis supporting the Coalition, while also eroding the confidence local Iraqis had in the ability of their own government to provide basic essential services. An essential element for the establishment of a democracy in Iraq required a stable population, which views its government as credible and able to provide for its citizens.

In April 2004, in support of the interim Iraqi government, the CPA awarded the construction contracts for large conventional WTPs in Nassiriya and Erbil. Yet it can be argued that the provision of safe drinking water for approximately 1.15 million people was the secondary objective of the WTPs;⁴⁰ the primary objective was to influence the large section of local population "sitting on the fence" of whether to support the Coalition or insurgency. The positive psychological change in the population would result in a more stable population and reduced violence, both critical ingredients for the establishment of a successful democracy. Even though this preceded the official concept by more than three years, the desire to stabilize and positively influence the Iraqi population via the provision of essential services is the cornerstone of the "COIN" message.

³⁹ Doyle, Brendan, "Iraq Watching Briefs – Water and Environmental Sanitation," UNICEF, July 2003.

⁴⁰ According to project file documentation, the Nassiriya WTP was to provide potable water to 550,000 Thi-Qar residents, while the Ifraz WTP was to provide potable water to 600,000 Erbil residents.

Unrealistic Goals and No Strategic Plan

Initial assessments in 2003 predicted that a minimum of \$4 billion to \$6.5 billion would be needed to restore and expand Iraq's water and sanitation sector. The USG originally obligated \$4.6 billion for the water and sanitation sector; however, the CPA later reprogrammed \$2 billion to address other priorities, such as improving security and increasing employment.⁴¹ In April 2004, the CPA's goals for the water and sanitation sector were to increase potable water access to 90% of Iraqis, increase sanitation access to 15% of Iraqis, and reduce water losses within the distribution network by 20%.⁴² Yet, this goal was unrealistic because no reliable baseline data existed on the condition of Iraq's water sector. For example, most data on Iraq's water sector came from international relief organizations from the late 1990s to the start of the 2003 Gulf War. While the war did minimal damage to the water sector, the insurgency and widespread looting caused significant damage; resulting security issues limited the CPA's ability to gather on-site condition data on Iraq's water infrastructure. In addition, Iraq's foreign experts who operated the water sector since the 1970s began to flee the country as early as the first Gulf War; with them, they took a majority of the institutional knowledge of the water sector.⁴³ Finally, the last "official" census of Iraq occurred in 1997. With increasing violence, Iraq experienced significant migration within the country. Minority groups either moved or were forced to flee from their existing neighborhoods and cities in search of "safer" areas. This resulted in a large number of internally displaced people within Iraq. Therefore, in 2004, the CPA did not have reliable data to estimate the amount of individuals to be served by a particular project.

While the CPA had the strategic goal of increasing potable water access, a strategic plan was essential to implement a comprehensive water sector strategy to achieve this goal. The CPA needed a plan to identify the current number of Iraqis without access to potable water, analyze the existing water sector infrastructure, project population growth rates, identify any projects to be funded by international agencies and donors, create a prioritized list of all potential U.S. funded projects, and establish outcome metrics to determine if funded projects are achieving the goals.

Project Outputs but No Outcomes

The CPA established output metrics for each WTP. The Nassiriya WTP was to produce 10,000m³/hour of potable water to provide 550,000 Thi-Qar⁴⁴ residents with 450 lppd; while the Ifraz WTP was to produce 6,000m³/hour of potable water to provide 600,000 Erbil residents with 240 lppd. However, the ability to measure the number of Iraqis served and individual water usage is limited by the lack of household water meters. Iraq does not have a comprehensive system of area meters or residential meters to determine how much water in the distribution network actually reaches intended users. Water distribution networks are subject to some water loss or undocumented water usage, which can occur through leakage, unmetered but legitimate use, or illegal connections (taps).⁴⁵

Yet, the CPA did not establish outcome metrics for each WTP. According to each project's funding documentation, the WTP was to "promote hygiene and better health care, reduce illnesses due to water born diseases and reduce child mortality." The Nassiriya WTP project

⁴¹ "Rebuilding Iraq: U.S. Water and Sanitation Efforts Need Improved Measures for Assessing Impact and Sustained Resources for Maintaining Facilities," U.S. Government Accountability Office, 7 September 2005, <<http://www.gao.gov/products/GAO-05-872>>.

⁴² *Ibid.*

⁴³ Doyle, Brendan, "Iraq Watching Briefs – Water and Environmental Sanitation," UNICEF, July 2003.

⁴⁴ "Thi-Qar" is often spelled "Dhi-Qar." For consistency throughout this report, unless used verbatim, SIGIR will refer to the United Nations' accepted spelling "Thi-Qar."

⁴⁵ "Rebuilding Iraq: U.S. Water and Sanitation Efforts Need Improved Measures for Assessing Impact and Sustained Resources for Maintaining Facilities," U.S. Government Accountability Office, 7 September 2005, <<http://www.gao.gov/products/GAO-05-872>>.

documentation referred to the critical situation in central and southern Iraq in terms of the number of cases of water-borne illnesses, such as typhoid, cholera, and malaria. However, there is no reliable baseline data for the actual number of water-borne illnesses cases by province or percentage of the population suffering from specific illnesses. With a project-specific goal of reducing water-borne illnesses and child mortality, detailed health records documenting the precise number of people suffering from illnesses and the child mortality rate are critical to establish a baseline to compare future data. Without a baseline, any population health data gathered at a later point in time will not provide conclusive evidence of improvement or regression.

Finally, the CPA did not establish any metric for measuring the long-term impact of each project. While each project had measurable output metrics in terms of quantity and quality of water produced, this can only be measured at each WTP. Even if the WTP produces the required amount and quality of water, the water still has to travel through the transmission and distribution lines prior to arriving at individual households. An old distribution line can allow leakage of water or the entrance of pathogens into the water supply. In addition, illegal taps to either the transmission or distribution networks result in less water availability. Consequently, the CPA needed to establish a metric to measure Iraqi satisfaction as a result of each project. For instance, did the local populations served by the Nassiriya and Ifrac WTPs experience an increase in water quantity and quality?

The *National Strategy for Victory in Iraq* identified the provision of essential services as a critical goal. Over the years, due to the security situation, the CPA and its successor agencies tracked the number of projects started and completed, but did not measure the impact of each project to this goal. As the COIN doctrine of winning “hearts and minds” became more of a focal point for “success” in Iraq, the USG could no longer assume that every completed water project automatically had a positive impact (that is, provided additional quantity and quality water to more of the population). Instead, the USG needed to be cognizant that the Iraqis’ perception of water quantity and quality are the most important measures of the impact of a project. If the local population is not satisfied with the project, then little will be achieved in terms of winning “hearts and minds.”

Possible Explanation for Locations of the WTPs

On April 21, 2004, the CPA awarded two separate task orders, in the amount of \$277 million and \$185 million, to FluorAmec to construct the Nassiriya and Ifrac WTPs, respectively. SIGIR reviewed available project file documentation and held discussions with U.S. reconstruction officials to determine the reason(s) why the CPA decided to award WTPs, in the combined amount of approximately \$462 million, to two specific areas in Iraq.

SIGIR’s review identified generic project-specific goals. For example, the CPA funded each project with the individual goal of “promoting hygiene and better health care, reduce illnesses due to water borne diseases, and reduce child mortality” through the increase of potable water. Yet, neither the individual task orders nor the project files documented the rationale for awarding the WTPs to these specific areas of Iraq; instead the project files simply documented the goal of providing potable water to an additional 1.15 million Iraqis.⁴⁶ Considering the dismal state of the entire Iraqi water sector, an argument could be made that each of Iraq’s 18 provinces was worthy of safe drinking water via a state-of-the-art, conventional WTP, especially considering several other Iraqi provinces had a larger population than Nassiriya and Erbil, such as Basrah, Ninewa, and Sulaymaniyah. Reconstruction officials who inherited the CPA projects upon its dissolution stated that CPA officials often did not adequately document the rationale for project

⁴⁶ The 1.15 million Iraqis consist of 550,000 Thi-Qar residents and 600,000 Erbil residents.

selection and/or funding. In the case of these two WTPs, reconstruction officials could not identify the justification for choosing these two locations for the WTPs.

After reviewing additional documentation, including international reports on Iraq's water sector, SIGIR pieced together potential explanations why the CPA may have identified Nassiriya and Erbil as the most deserving areas for the WTPs. The Thi-Qar Governorate, of which Nassiriya is the capital, suffered from a 43% deficit between water demand and supply;⁴⁷ while projections called for Erbil's population to almost double over the next 20 years,⁴⁸ thereby significantly increasing demand on an already overworked water sector. In addition, and possibly more important, Nassiriya harbored resentment toward the USG from the aftermath of the 1991 Gulf War. Providing safe drinking water to a significant portion of Nassiriya may have been an attempt by the CPA to influence that population toward a more positive outlook of the USG. Contrasting Nassiriya with Erbil, which viewed the USG favorably after the 1991 Gulf War; Erbil's security and stability allowed the U.S. military to focus its attention to "hot spots," such as Baghdad and Nassiriya. The CPA may have intended to encourage Erbil's support via the provision of a desperately needed WTP.

Appendix A provides more specific information regarding the possible justifications for choosing Thi-Qar and Erbil as locations for the two WTPs.

Background Summary

The USG quickly achieved its initial strategic goal of removing Saddam Hussein from power by May 2003. After that, the USG's original medium- and long-term strategic goals of a stable, peaceful, and democratic government in Iraq were threatened by an unrelenting, deadly insurgency and an Iraqi government unable to provide sufficient essential services to its citizens. As a result, the USG changed strategy from attempting to counter terrorism through combat operations to countering terrorism and violent extremism through activities aimed to promote developmental goals of stability and good governance.

The USG issued two publications documenting this switch in strategic goals: the *National Strategy for Victory in Iraq* and the COIN FM. Both documents envisioned a path toward success in Iraq through the winning of "hearts and minds" of the local population and establishment of a stable Iraqi government viewed by its people as credible, representative, and the embodiment of national interests as well as addressing their basic needs.

The *National Strategy for Victory in Iraq* defined the end state of Iraq as a nation that is "peaceful, united, stable, democratic, and secure." This document presented a "comprehensive" strategy, which included three integrated tracks—political, security, and economic—each with separate objectives. The COIN FM identified the Iraqi local population as key to the success of a stable and democratic Iraq. The COIN FM stressed the importance of meeting the essential services needs of the local population in order to win their "hearts and minds." As a result, the *National Strategy for Victory in Iraq* identified the USG's goals; while the COIN FM doctrine became the implementation vehicle to achieve the goals.

Improvements in critical infrastructure and a competent and functioning Iraqi government were expected to increase the quantity and quality of essential services, such as electricity, potable

⁴⁷ "New Eden Master Plan for Integrated Water Resources Management in the Marshlands Area, Volume III, Implementation Plans, Book 7, Water and Sanitation assets," Iraqi Ministries of Environment, Water Resources, and Municipalities and Public Works, 2006.

⁴⁸ "Agriculture Reconstruction and Development Program for Iraq, Strategy for Water and Land Resources in Iraq, Phase 1 Project Completion Report, Volume 3 – Annexes 1 – 15," USAID, October 2006.

water, and sewage treatment, to its people. At that point, the USG wanted to “establish the conditions for a free, sovereign, democratically elected representative government” in Iraq.⁴⁹

By the early 1990s, Iraq’s water sector was well developed and modern, equipped with sophisticated Western-designed and -dependent technologies. However, by 2003, two wars, international sanctions, and mismanagement by the Saddam Hussein government resulted in the devastation of the Iraqi water sector. The estimated efficiency of the existing drinking water production facilities ranged between 40% and 60% of the design capacity, with water losses amounting to 50% of all water produced.

In addition:

- Urban access to potable water fell from 95% to 92%; however, quantities of water in Baghdad fell from 330 lppd to 218 lppd and in other cities from 250 lppd to 171 lppd
- Rural access to potable water fell from 75% to 30%, and quantities of water fell from 180 lppd to 91 lppd
- Water losses from old age and corrosion of pipes and illegal tapping rose to 60%

As a result, Iraq suffered from a fast-growing problem of malnutrition, morbidity, and mortality of infants and under-five-year-old children. For example, infant mortality rates between 1984 and 1999 rose from 47 to 108. In addition, Iraq saw a dramatic increase in typhoid fever cases, Giardiasis, and malaria.⁵⁰

The CPA recognized that rehabilitating Iraq’s water sector offered one of the greatest opportunities for development impact in the post-conflict environment. Providing “safe” drinking water to a desperately thirsty nation, in fact, had more than just a development impact; it presented an opportunity to influence the opinion and beliefs of the Iraqi population toward the Coalition and the USG. The CPA’s water goal was to provide potable water to 90% of Iraqis.⁵¹ On April 21, 2004, the CPA awarded two separate task orders, in the amount of \$277 million and \$185 million, respectively, to construct the Nassiriya and Ifraz WTPs. At the time, Thi-Qar province suffered from one of the worst water-shortage deficits in Iraq; while Erbil’s water supply system suffered from a lack of potable water production and a poor water distribution network.

The CPA established output metrics for each WTP—produce 10,000 m³/hour to provide potable water for 550,000 Thi-Qar residents, and produce 6,000 m³/hour for 600,000 Erbil residents. However, the ability to measure the number of Iraqis served and individual water usage was limited by the lack of household water meters.⁵² In addition, the CPA did not establish outcome metrics or any metric for measuring the long-term impact of each WTP.

⁴⁹ “Coalition Provisional Authority, Baghdad, Iraq Achieving the Vision to Restore Full Sovereignty to the Iraqi People (Strategic Plan),” 1 October 2003.

⁵⁰ Doyle, Brendan, “Iraq Watching Briefs – Water and Environmental Sanitation,” UNICEF, July 2003.

⁵¹ “Rebuilding Iraq: U.S. Water and Sanitation Efforts Need Improved Measures for Assessing Impact and Sustained Resources for Maintaining Facilities,” U.S. Government Accountability Office, 7 September 2005, <<http://www.gao.gov/products/GAO-05-872>>.

⁵² Ibid.

Nassiriya Water Treatment Plant

Current Operating Status Falls Short of Construction Design

The objective of the Nassiriya WTP project was to design and construct a new water supply system consisting of a new WTP capable of producing 240,000 m³ per day of potable water and approximately 110 km of transmission piping⁵³ for five cities within Thi-Qar province. Costing approximately \$277 million, the Nassiriya Water Supply project, which included the Nassiriya WTP and associated facilities and transmission lines, is the largest single reconstruction project funded by the USG in Iraq.

The project was originally conceived as a cost-sharing project with the GOI. The USG would fund the water supply project and the GOI would fund the power from the national grid required to operate it; repair the leaks in the existing distribution system to allow potable water to flow from the conveyance lines to the end user; and provide a qualified and motivated staff to be trained to operate and maintain the facility after the project was turned over to the GOI. More importantly, this project provided the opportunity for the GOI to show its citizens that it could consistently provide an essential service.

SIGIR previously inspected the Nassiriya WTP project, visiting the facility twice between December 2007 and February 2008. SIGIR documented its findings in report PA-07-116, *Nassiriya Water Treatment Plant*, April 28, 2008.⁵⁴ SIGIR found a well-constructed WTP operating well below its design capacity. Instead of producing 240,000 m³ of potable water per day (10,000 m³/hour), the plant was operating only one shift of eight hours a day and producing between 2,000 and 2,300 m³/hour of potable water. In addition, the amount of finished water was only enough for three of the five cities it was designed to serve because of illegal taps into the transmission lines and poor distribution systems. Consequently, the WTP was only producing 20% of its designed output and serving only 60% of the intended cities. The SIGIR Inspections report cited the inability of the GOI to provide reliable power, improve the old distribution network, remove illegal taps in the transmission line, and provide a qualified and motivated staff to attend O&M training as the main reasons for the water system's poor overall performance.

After SIGIR's 2008 site visit, some small, yet significant improvements were reported by the Iraqi Ministry of Municipalities and Public Works (MMPW), which stated the WTP had increased finished water production to 6,000 m³/hour within two weeks of SIGIR's second visit to the WTP. This increase in water production was, however, for only one eight-hour shift per day (instead of 24 hours per day).

On May 12, 2010, SIGIR again visited the Nassiriya WTP. The USG turned over the operation and security of the project to the GOI on September 12, 2007; therefore, at the time of SIGIR's site visit, the GOI had operated the facility for 32 months. SIGIR toured the facility and spoke with WTP personnel to determine if any of the previously identified issues had been corrected and if there was any impact on the WTP's ability to produce potable water.

SIGIR observed that several previous issues had been resolved; several important issues remain problems; and several issues could not be verified. For example, SIGIR noticed a significantly larger WTP staff size to operate and maintain the facility, which addressed at least one prior

⁵³ Transmission (or conveyance) pipelines carry the potable water from the WTP to the distribution network within each city, and the distribution network delivers the water to the end user.

⁵⁴ This report can be retrieved from SIGIR's website at www.sigir.mil.

operational issue.⁵⁵ However, due to time limitation on site, SIGIR could not determine the operational and maintenance abilities of the WTP staff. In addition, in SIGIR’s September 2007 visit, SIGIR identified that Clarifier Number 4 was out of service due to sludge buildup. SIGIR determined this occurred due to lack of routine maintenance, which was endemic at the WTP at that time. During the May 2010 visit, SIGIR examined Clarifier Number 4 again, which appeared to be functioning (Site Photo 1). The scraper arm was rotating within the tank and effluent was discharging as appropriate over the perimeter weir. It appeared that Clarifier No. 4 had been adequately and routinely cleaned since the time of SIGIR’s first visit. However, SIGIR noticed a significant difference in water clarity between the working clarifiers from September 2007 (Site Photo 2) and the clarifiers from the May 2010 visit (Site Photo 1). Specifically, the effluent leaving the clarifiers in September 2007 was considerably bluer in color than the effluent leaving the clarifiers in May 2010. SIGIR observed in May 2010 that there was little difference in color between the effluent leaving the clarifiers and the clarifier center tank.⁵⁶ According to the U.S. Embassy’s Environment, Science, Technology, and Health officer, the lack of color difference between the effluent leaving the clarifiers and the clarifier center tank is an indication that an insufficient amount of alum was used in the process that will result in “finished” water with excess turbidity.



Site Photo 1. Operating clarifiers



Site Photo 2. Clarifier from December 2007 SIGIR visit

In addition, in SIGIR’s previous site visits, only one vertical turbine pump was operational; while five other vertical turbine pumps were out of service. During the May 2010 visit, the plant

⁵⁵ For SIGIR’s 2008 site visit, approximately 15 WTP workers were present at the plant, while during the May 2010 visit, at least 30 WTP workers were present at the plant.

⁵⁶ The clarifier center tank collects flocculated solids previously subjected to the rapid mix step and sludge solids raked from the clarifier’s bottom. Solids are removed from the clarifier center.

manager stated that the five vertical pumps had been repaired and all six were operational (one serves as a spare).

While the operation and maintenance of the WTP had significantly improved, SIGIR did identify several areas where routine maintenance was inadequate. For example, the metal-bar screens for the raw water intake were clogging with debris from the river. Specifically, vegetation from the river was getting caught on the bar screen and creating an obstruction. WTP personnel did not clean the bar screens, which limited the amount of raw water entering the WTP.

SIGIR previously identified that the WTP's flow meters, which measure the flow of finished water leaving the plant to the transmission lines, had been removed. During the May 2010 visit, SIGIR verified that flow meters had been re-installed and were operating. The use of flow meters provides a more reliable method of determining the amount of total finished water output; previously, the WTP operators "backed into" the water output number by figuring the number of clarifiers and filters being operated, which was not an accurate method to determine the actual amount of finished water produced.

During SIGIR's May 2010 visit, the technical supervisory control and data acquisition (SCADA)⁵⁷ system did not work. According to the plant manager, the SCADA system "has never worked;" even though project file documentation indicated the SCADA system operated when tested during commissioning (prior to turnover to the GOI).

An issue that had only marginally improved was permanent, reliable, clean⁵⁸ power for the WTP. Since the onset of the project in April 2004, the GOI was responsible for providing permanent, reliable power for the WTP and three booster pump stations (BPS) that convey the water to the five cities. In SIGIR's original visit to the WTP, the facility was operated solely on generator power; while during the second visit, the WTP was operated on municipal power. However, the municipal power was unreliable and intermittent; for instance, the power would run for 10 minutes and then be off for the next 5 minutes repeatedly throughout the day and with no advance notice. WTP representatives stated this not only affected the WTP's productivity, but also harmed some of the plant's sophisticated and delicate equipment. A former U.S. Army Corps of Engineers representative stated that, if properly maintained, the WTP equipment should have a lifespan of approximately 30 years; however, due to the hard stops and hard starts caused by the intermittent municipal power, at least 10 years of the equipment's lifespan had already been expended.⁵⁹

During the recent site visit, the plant manager stated that the WTP was operating on municipal power. SIGIR witnessed instrumentation in the transformer room, indicating power from the main utility lines (with no standby generators operating). The plant manager said the municipal power, while better, is still not reliable and service is often interrupted, which forces the WTP to operate on generator power. The plant manager complained that the WTP was not adequately designed because the WTP's capacity is only approximately 20% when utilizing the generators, indicating that he felt that the WTP should have sufficient generator capacity for 100% operation. However, since specific units of equipment require a significantly large amount of power to operate, such as high-service pumps, the WTP was made to utilize power from the national grid and use generators as a backup source. The original design required backup generators to operate only one single high-service pump; the intent was never to operate the WTP utilizing generator power only.

⁵⁷ SCADA systems are widely used in water treatment facilities to assist operators by automating certain operating, trouble shooting, and data logging functions.

⁵⁸ By "clean" power, SIGIR refers to stable electrical voltage and frequency supply without surges.

⁵⁹ Interview with a U.S. Army Corps of Engineers representative, Nassiriya, Iraq, February 2008.

In addition, according to the plant manager, the dedicated power service line to the WTP has been tapped by residential customers and often overloads. The nearby power plant frequently cuts power to this line in order to shed load and thereby avoid electrical grid failure. Further, the plant manager also stated that there are problems supplying power to the BPS along the transmission main. The transformers supplying power to several of the BPS have failed. In one case the Ministry of Electricity (MOE) brought in a mobile transformer to restore power; however, in another case, the BPS remains offline and has had to be bypassed. The water distribution system is not designed to function with a BPS bypassed and this may create an overload condition for other pumps in the system.

In its April 2008 report, SIGIR noted the WTP's on-site Water Quality Laboratory, which should monitor the quality of the raw water, treated, and finished water at various stages of the treatment process for operational control purposes, did not have the necessary equipment to perform these required, technical tests. Consequently, SIGIR questioned the authenticity and validity of the WTP's daily test results. In May 2010, SIGIR observed an improved laboratory facility. While the laboratory appeared to be well stocked and contained equipment to perform various tests to ensure the treated water conformed to international standards, the overall condition of the laboratory was dirty. For example, the "Jar Test" apparatus determines the amount of aluminum sulfate required to be added to incoming water to cause flocculation and settlement of particulate matter in the raw water. This information is utilized to adjust the treatment process based on the amount of particulate in the raw water entering the plant. SIGIR noticed the "Jar Test" apparatus, which was missing in SIGIR's previous site visits, had not been cleaned recently; the six jars were dirty with a coating of dirt and grime on each jar from top to bottom.

According to the Environmental Protection Agency, excessive turbidity⁶⁰ in drinking water represents a health concern. Turbidity can provide food and shelter for pathogens; if not removed, turbidity can promote the re-growth of pathogens in the distribution system, leading to waterborne disease outbreaks. The original WTP was designed to achieve a treatment goal of 0.5 Nephelometric Turbidity Units (NTU),⁶¹ with a maximum turbidity rate of 1.0 NTU. Since the World Health Organization (WHO) standard for treated water is 5.0 NTU, both the design goal and maximum turbidity rates are significantly lower, which ensures maximum opportunity for microbial removal and improved public health protection. During SIGIR's 2008 site visit, the turbidity readings for the day at four separate times were the following: 1.8 NTU, 2.0 NTU, 2.8 NTU, and 2.5 NTU. During the May 2010 visit, SIGIR observed recorded readings of the following: 2.5 NTU, 3.7 NTU, 3.8 NTU, and 3.9 NTU. While all readings are below the WHO standard of 5.0 NTU, the WTP's turbidity rates are well outside the design maximum turbidity rate of 1.0 NTU. Consequently, SIGIR is concerned the WTP is supplying finished water with potentially more pathogens to the end users of Nassiriya. In addition, since the turbidity rates are increasing, SIGIR questions the ability of the WTP staff to effectively operate the plant.

During the May 2010 visit, the plant manager stated the WTP is operated at 100% capacity during the summer months and at 60% capacity during the winter months, 24 hours a day, seven days a week. With SCADA reading unavailable, SIGIR took readings from the high-service pump control panels, which recorded a finished water "flow" reading of 6,141 m³/hour. While this number does reflect a significant increase in finished water production than earlier SIGIR visits, it is still only 61% of the design capacity. In addition, due to security concerns, SIGIR's May 2010 visit was limited to two hours on site. Consequently, SIGIR could not verify the WTP was operating 24 hours a day, seven days a week, as claimed by the plant manager. SIGIR

⁶⁰ Turbidity is the cloudiness or haziness of a fluid caused by individual particles or suspended solids in the fluid.

⁶¹ NTU is the turbidity standard unit of measurement. A property of particles is that they will scatter a light beam focused on them. NTU measures the amount of light being scattered, and a higher NTU measurement means that a larger number of suspended particles are present in the water.

questions the ability of the WTP to operate 24 hours a day, seven days a week. First of all, Nassiriya, like the rest of Iraq, suffers from extended daily power outages; Nassiriya often received only four to eight hours of electricity per day. Even though the WTP was supposed to be on a dedicated electrical line, countless illegal taps into the line by nearby residents caused overloads and frequent power cuts. In times when no electrical power was available, the WTP would operate solely on generator power; however, a considerable amount of diesel fuel is required to operate the generators. According to the plant manager, the MMPW did not always provide enough fuel for the generators. Consequently, during times when electrical power and generator power are unavailable, the WTP will not operate. Further, the WTP's production of finished water when operating on generator power is limited to 20% (2,000 m³/hour), which is considerably less than the 100% or 60% capacity claimed as a minimum by the plant manager.

Perceptions of Public Officials and the Population Generally Negative

Iraqi Public Officials

SIGIR held roundtable discussions with several Thi-Qar provincial government representatives, including two Provincial Council members, the Shattra mayor, and a senior-level MMPW official to discuss the impact of the Nassiriya WTP. According to one Provincial Council member, the Nassiriya WTP is the “lifeblood for the province.” Providing context for the statement, he said, “Southern Iraq suffered for many years from a shortage of water, which resulted in severe diarrhea and death for many people. We had to take water pills,⁶² but in the late 1980s and 1990s, we ran low on pills. This project eliminates the need for water pills.”

According to the group, the Nassiriya WTP provides “good” quality water for approximately 900,000 citizens in Thi-Qar province. It operates at 100% capacity during the summer months and 60% capacity during winter months, which according to the Provincial Council member, is “based upon demand.” According to their calculations, the average amount of water provided is 450 lppd and 350 lppd for urban and rural residents, respectively.

However, provincial government representatives and the senior-level MMPW official also expressed their frustrations with this project. The primary problem is the lack of reliable electrical power for the WTP and BPS, which requires operation by generators, reducing capacity to 20% or the complete shutdown of the WTP. Thi-Qar province, like every other province in Iraq, suffers from power outages of 16 to 20 hours per day. In addition, the dedicated service line to the WTP has been tapped by residential customers and often overloads. The nearby power plant frequently cuts power to this line in order to shed the load to avoid electrical grid failure. As a result, mobile electrical substations are used to provide power to the WTP and BPS. However, the mobile substations are “old and damaged” and often do not work.

The local Iraqi public officials also identified other issues affecting the WTP, which it would like USG assistance to correct:

- Poor contractor design of the facility because it only allows for 20% capacity when operated solely with generators
- Spare parts provided by the USG have been used and more are needed. Obtaining funding for spare parts through the Iraqi government is difficult
- Distribution network is old and needs replacement, which is the primary reason why water is not reaching all the homes and people are upset
- USG did not provide a crane for WTP staff to use for maintenance
- SCADA system never worked

⁶² The “water pills” are chlorine dioxide water purifier tablets, which kill bacteria, viruses, giardia, and cryptosporidium in non-potable water. One tablet treats one liter of water.

- Too many illegal taps into the distribution system by farmers in the Diwayah area, which results in low water pressure
- Garraf River is full of weeds, which clog the metal screen bars for the raw water intake, limiting the amount of raw water entering the WTP.

SIGIR asked if the MMPW utilizes meters to determine the amount of per household usage and charges accordingly. SIGIR pointed out that recurring fees for water usage are important to avoid overconsumption of water and also provide revenue for maintenance of the WTP and distribution network, along with new projects to produce additional potable water for areas without regular water access. The Provincial Council members stated that the MMPW does not currently use meters; instead, they calculate the amount of water usage based upon the capacity of a reservoir, the number of times it needs to be filled divided by the number of people living in the area. According to the Provincial Council members, even without meters, each resident is charged for water usage; however, the water fee is rarely collected. The Provincial Council members stated that in 2011, meters will be installed in every household to determine the exact amount of water usage and fees will be charged and collected.

Finally, the local Iraqi public officials wanted to know when the USG was going to fund the “second WTP.” According to the Provincial Council members, the population of Thi-Qar province has increased from 1.2 million in 2004 to 1.85 million in 2010. The Nassiriya WTP provides “good” quality water to 900,000 residents, which leaves 950,000 residents without access to it. The overall master plan for this project, when initiated in 2004, was based on an ultimate capacity of 20,000 m³/hour. The Nassiriya WTP, as designed and constructed, incorporated an option to expand its treatment capacity from 10,000 m³/hour to 20,000 m³/hour.⁶³ However, according to former Iraq Transition Assistance Office Water representatives, they regularly advised the GOI between 2005 and 2007 the USG did not have the resources to fund the expansion of the WTP.⁶⁴ The Government of Japan later surfaced as a potential donor to fund the expansion, but as of May 2010, there have been no further developments with regard to expansion. The Provincial Council member said the Government of Japan has not contacted them regarding the expansion of the WTP. The Provincial Council members stated that since the Government of Japan appears to have decided against funding the expansion of the WTP, the USG should fund it.

Local Population

SIGIR utilized focus group comments and flash polling data, collected in July and August 2010, from the local population served by the Nassiriya WTP to gauge their perceptions about this project. A representative group of the local population from the five cities receiving finished water from the Nassiriya WTP was asked to comment on the quantity and quality of water received, reasons for shortfalls in water availability, efforts to improve water coverage, and the cost of water.

The Nassiriya WTP became operational in September 2007 to resolve the potable water quality and quantity problems identified earlier in this report. Prior to the WTP, a significant portion of the Thi-Qar province was not connected to the general water network; for example, more than half of the residents in cities such as Shatra, Diwaya, and Suq Al-Shoyokh were not connected to a regular water source (Figure 1).

⁶³ The expansion involves doubling the present number of clarifiers and increasing the capacity of the filtration system. A parcel of land on the property has been identified as capable of accommodating the additional units. However, the plant’s conveyance system was designed and constructed to accommodate only the present capacity; this capacity constraint was, according to project documentation, due to funding limitations. Another option is to provide a sludge bed, to treat sludge prior to disposal, and a pH adjuster as part of the future expansion.

⁶⁴ The expansion option for the WTP was estimated to cost in the tens, if not hundreds, of millions of dollars.

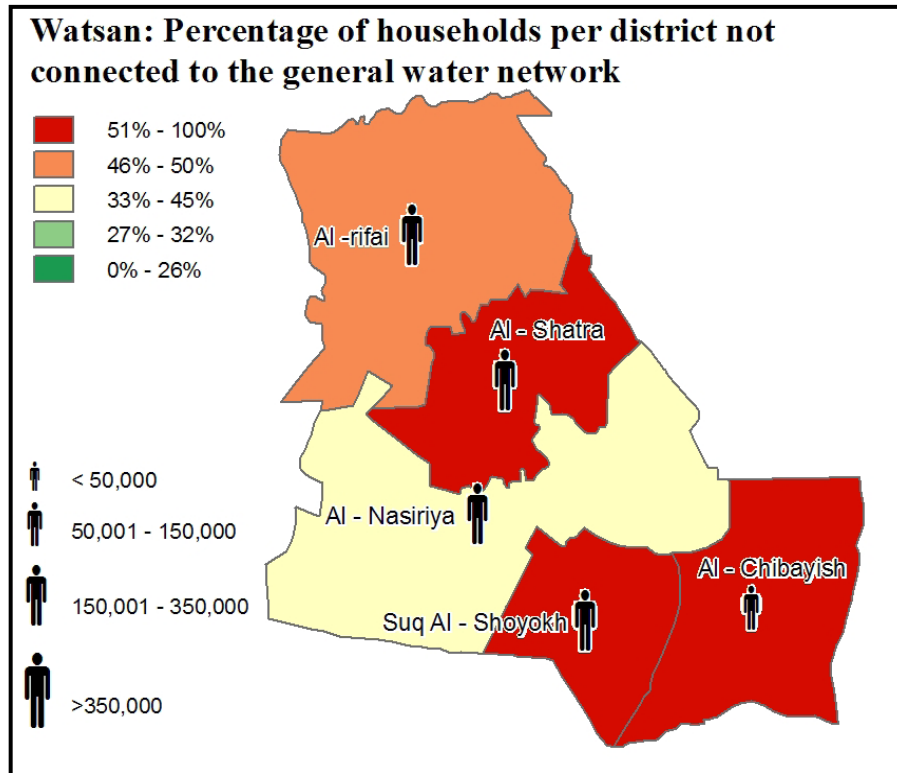


Figure 1. Percentage of Thi-Qar households not connected to general water network in 2007
(Courtesy of the UN Office for the Coordination of Humanitarian Affairs)

Even though these communities are now connected to the Nassiriya WTP, with respect to the availability of water, virtually no one is very satisfied and only 23% are “somewhat satisfied;” in contrast, 43% of the population is either “somewhat dissatisfied” (25%) or “very dissatisfied” (18%). A major source of their frustrations is the fact that, in some areas, “the water is available three hours during the full day.”

In addition, only 35% believed the availability of running water in their homes had improved since 2007 (before the WTP became operational). Opinions varied when it came to placing blame on the lack of increased water availability; however, most Nassiriya residents recognized the shortage of electrical power contributed to water shortages, and a significant portion of the local population is concerned “*there will not be enough electrical power to keep the water treatment plant working*” in the coming years. At present, “*if the power cuts off, we will not see the water, which will force people to go [to] the river.*” However, as mentioned throughout this report, the main rivers in Iraq, the Tigris and Euphrates, their tributaries (including the Garraf and Shatra rivers), and their streams are not fit for human consumption without significant purification treatment. Yet, the lack of reliable permanent power to the Nassiriya WTP severely limits its production capabilities, which forces Thi-Qar residents to collect water from nearby rivers and streams (Site Photo 3).

In terms of water quality, no residents receiving water from the Nassiriya WTP are very satisfied and just 5% are “somewhat satisfied;” however, 76% are either “very dissatisfied” (53%) or “somewhat dissatisfied” (23%). A common sentiment was that the “water quality is very poor and it is unfit for drinking—it has a lot of impurities.” One woman from



**Site Photo 3. Example of a local Iraqi securing water from a stream
(Courtesy of the UN Environment Programme)**

Suq Al Shoyokh went so far as to say the “tap water is not [even] good for laundry [purposes].” To further clarify their dissatisfaction and fear with the quality of water, 16% stated members of their households have experienced illnesses, such as diarrhea, in the last 12 months, which they attributed to poor quality water. To remedy this situation, a majority of Thi-Qar residents “do not drink this water, therefore we are not affected” with water-borne illnesses. In fact, only 14% of the Thi-Qar residents say their main source of drinking water is from the WTP.

Consequently, even though this WTP was designed and constructed to produce 240,000 m³/day of finished water with a maximum turbidity rate of 1.0 NTU, the majority of Thi-Qar residents receiving finished water from the Nassiriya WTP are dissatisfied with the quantity and quality of water. Residents in each area of Thi-Qar said the WTP has made no impact on the quantity or quality of their household water whatsoever. The dissatisfaction with the quality of the water is so profound that only 14% use it as their main source of drinking water; the remaining 86% either purchase water or use water from a nearby river or stream.

Nearly all stated they pay for running water to their households; however, this contradicts the statement made by the Provincial Council members who stated that water fees are rarely collected. More specifically, the local population stated their payments consisted of formal fees and bribes, so it is quite possible that their “payments” for water availability are, in effect, “bribes” to the corrupt government officials blamed for the lack of increased water availability. Thi-Qar residents appeared to be resigned to Iraqi government corruption being involved in the water process because they “do not expect that there is a place in Iraq where there is no corruption.”

Finally, even though the USG expended over \$277 million for this project, only 3% of the local population believes the USG provided even “limited assistance” in improving access to clean water in the area. Focus group participants in the Nassiriya area appeared to be largely unaware that the USG constructed the Nassiriya WTP. At the thought of the USG funding the Nassiriya WTP, nearly all participants indicated it did not change their feelings towards the USG. The words of one Thi-Qar woman reflected the view of many: “I do not have any love or favor toward them. Our [negative] views will not change toward the United States.”

Impact on Strategic Goals Difficult To Determine

As mentioned earlier in this report, the USG quickly achieved its initial strategic goal of removing Saddam Hussein from power; however, an unrelenting and deadly insurgency and an ineffective Iraqi government threatened the medium- and long-term strategic goals of a stable and democratic government in Iraq and the Middle East.

Stable and Democratic Iraq

In 2004, the USG found the Thi-Qar province in shambles, with an ineffective local and national government unable to provide sufficient potable water to its citizens, and a growing insurgency actively pursuing new recruits. As a result, water-borne illnesses reached an alarming rate and the local population was losing patience with its government and leaning toward the insurgency. In addition, many Thi-Qar residents felt resentment towards the USG for not supporting their efforts during the 1991 uprising against Saddam Hussein.

The USG changed strategy from attempting to counter terrorism through combat operations to countering terrorism and violent extremism through activities aimed to promote developmental goals of stability and good governance. In 2004, the CPA identified the provision of essential services, such as potable water, as one of four “core foundations;” while in 2005, the *National Strategy for Victory in Iraq* identified the root causes of the insurgency as an unstable Iraq and the lack of confidence in the GOI due to its inability to provide essential services to its citizens. As a result, the USG appropriated \$18.4 billion for the reconstruction of Iraq’s infrastructure to assist, among other things, the provision of essential services.

The Nassiriya WTP, the largest single USG-funded project in Iraq, encompassed the primary themes from the CPA Strategic Plan, the *National Strategy for Victory in Iraq*, and later the COIN doctrine. The construction and initial operation of the WTP would satisfy the CPA strategic goal of providing an essential service; while the continued operation of the WTP would address the *National Strategy for Victory in Iraq’s* goal of building capacity within the GOI to maintain infrastructure. Finally, the long-term successful operation of this WTP would provide potable water to the local population and help reduce the number of water-borne illnesses and mortality rates. The CPA Strategic Plan and *National Strategy for Victory in Iraq* objective was to help stabilize the area and legitimize the GOI in the eyes of the local population, while the COIN doctrine is that such actions help win the “hearts and minds” of the local population.

Good Governance

The CPA Strategic Plan, *National Strategy for Victory in Iraq*, and COIN doctrine envision an effective government in place to capitalize on any security and stability gains made from the provision of essential services. This effective government must have the capacity to operate and maintain the infrastructure project after it is turned over by the USG.

For this project, the USG agreed to fund, construct, commission, and initially operate the WTP, while the GOI agreed to fund a dedicated, reliable permanent power source, repair all leaks in the

distribution network, and efficiently operate and sustain the project. Two SIGIR site visits and multiple discussions with U.S. reconstruction officials⁶⁵ and MMPW staff in 2007-2008 revealed a well-constructed facility with considerable operational and sustainability issues on the part of the GOI. To date, the significant issues identified in SIGIR's previous assessment are still unresolved. After more than 6 years, the GOI still has not provided a permanent, reliable electrical power source, repaired leaks in the distribution network, or supplied the necessary equipment and consumables to efficiently operate and maintain the WTP. Until these issues are adequately addressed, not only will the quantity and quality of finished water continue to decline, but the overall life expectancy of the WTP itself will deteriorate exponentially.

The basic criteria for "good governance" include the enforcement of laws and the provision of essential services. A government expecting to win over its population needs to aggressively seek out solutions to critical problems, such as the inability to deliver potable water to its citizens. However, discussions with local and national Iraqi public officials revealed not only a lack of urgency in resolving the outstanding issues, but an expectation that the USG should do more to help. For example, in SIGIR's 2008 report, a significant issue identified was illegal taps into the transmission and distribution lines, which reduce the water pressure and amount of water available to residents (Site Photo 4). According to WTP staff at the time, farmers in Diwaya tapped into the lines to use the finished water for their crops. Initially, the GOI complained to the USG that the USG needed to take action regarding the illegal taps into the transmission lines even though this clearly was a GOI responsibility. When U.S. reconstruction officials shut off water to Diwaya over the GOI's refusal to remove the illegal taps, local Iraqi government officials promised to have them removed. However, SIGIR was later told that the Diwaya mayor and city council declined to enforce the removal of illegal taps because "the farmers have guns." During our recent discussions, the Provincial Council members and MMPW official mentioned that illegal taps into the transmission and distribution networks are still a significant cause of reduced water pressure in the lines and amount of water available to residents.

In addition, the Provincial Council members acknowledged that the existing "dedicated" electrical power line for the WTP is illegally tapped by countless residents near the WTP, which overloads the power line and requires the nearby power plant to shut down the line. Instead of enforcing the removal of the illegal taps, the Provincial Council members stated that an old power line is available and "if the U.S. funds a small project to energize the line, we will make sure no one taps it." When SIGIR asked why the Iraqi provincial or national government does not fund this "small" project, the Provincial Council member said a "lack of funding." By not enforcing the removal of illegal taps of the transmission and electrical lines over the past three years, the local and national governments have, in effect, given tacit encouragement to this activity.

Finally, the Provincial Council members continued to request that the USG fund the expansion of the Nassiriya WTP, estimated between \$50 million to \$100 million, in order to provide finished water to the remainder of the Thi-Qar province residents. Yet, an expanded WTP would require double the amount of electrical power, consumables, and spare parts, which the GOI cannot currently provide for the current U.S.-funded WTP. Further, the GOI can only operate the WTP at approximately 61% of its capacity; there is little evidence to suggest the GOI could operate an expanded WTP.

⁶⁵ The reconstruction officials included representatives from the Iraq Transition Assistance Office (now ISPO), the U.S. Army Corps of Engineers, and the Thi-Qar Provincial Reconstruction Team.



Site Photo 4. Illegal taps in the transmission and distribution lines, which reduce the water pressure and amount of water available to residents (Courtesy of USAID)

As mentioned earlier, SIGIR asked if the MMPW utilizes household water meters to assess charges to encourage water conservation and generate revenue for operational expenses, including funding new projects. According to the Provincial Council members, the MMPW has spent approximately \$180 million on new projects since 2003, when asked; the Provincial Council members stated that they wanted to utilize this funding for new projects and not to pay for “problems” with the Nassiriya WTP, such as insufficient spare parts and generators.

Yet, even if the MMPW charged only a nominal amount for water usage, the GOI would be in a significantly improved position to fund the operation, maintenance, and sustainment of this project. Approximately 47% of Nassiriya area residents stated that they were willing to pay to improve water quality and quantity. The unwillingness of the GOI to install household meters and enforce the collection of fees has resulted in water wastage and reliance upon the USG to fund the operation and sustainment of the WTP. For example, Provincial Council members acknowledged farmers who use finished water for their crops and urban residents who water their lawns. Provincial Council members admitted that some residents use as much as 800-900 lppd. Provincial Council members stated that they will “try” to install household meters next year.

Even though this project meant to increase the confidence of the local population in the GOI, residents from all areas of Thi-Qar agreed that the “[Iraqi] government does not provide anything well.”

Security and Stability

In 2004, Thi-Qar province was anything but secure or stable. Poverty, violence, underdeveloped infrastructure, lack of essential services, and resentment towards the USG made Thi-Qar vulnerable to violent extremism and potential sources of political instability. Against this backdrop, the USG awarded the Nassiriya WTP with the secondary objective of providing safe drinking water to a desperately thirsty and sick province; the primary objective was to influence

the population that both the U.S. and Iraqi governments were sensitive to their needs for essential services.

Yet, residents from all areas of Thi-Qar did not believe their individual communities benefited from improved security resulting from the WTP project. Most did not even see a relationship between water treatment facilities and community safety. However, this poor-performing project and the GOI's inability to provide essential services threaten to de-stabilize the area. The majority of Thi-Qar residents are aware of the WTP, which they expected to provide the much-needed safe drinking water. But, after three years of patiently waiting for the water they claim is "unfit for drinking," Thi-Qar residents are frustrated and losing confidence in the GOI's ability to provide for their needs.

Impact of the Nassiriya WTP

The CPA's water sector goal was to increase potable water access to 90% of Iraqis; with the Nassiriya WTP project adding 550,000 Thi-Qar residents toward the achievement of this goal. However, the lack of household meters makes it impossible to determine the number of residents served by this WTP or the amount of water consumed. An outcome measure of the project was the improvement in the health of Thi-Qar residents by reducing the rate of water-borne illnesses and child mortality; yet, the CPA did not provide baseline health data to document either rate at the time the project was funded. Therefore, it is not possible to measure improvement in either water or health outcomes.

Further, the CPA did not establish either a baseline of the Iraqis' feelings toward the USG and its reconstruction program or a method for measuring the Iraqis' satisfaction with this specific project. SIGIR utilized recent focus group and flash polling data to assess the impact of this project. An overwhelming majority were dissatisfied with the quantity and quality of water from the WTP. In addition, even though the USG expended more than \$277 million for this project, only 3% of the local population believes the USG provided even "limited assistance" in improving access to clean water in the area. Focus group participants in the Nassiriya area appeared to be largely unaware that the USG constructed the Nassiriya WTP. At the thought of the USG funding the Nassiriya WTP, nearly all participants indicated it did not change their feelings towards the USG. The words of one Thi-Qar woman reflected the view of many: "I do not have any love or favor toward them. Our [negative] views will not change toward the United States."

Ifraz Water Treatment Plant

Current Operating Status Meets Construction Design

The objective of the Ifraz WTP⁶⁶ project was to design and construct a new water supply system consisting of a new WTP capable of producing 6,000 m³/hour of potable water, approximately 31 km of transmission piping, and a 20,000 m³ storage reservoir in northeast Erbil. This project, when completed, was to provide potable water for 600,000 people in Erbil. Costing approximately \$185 million, the Ifraz WTP project is the second largest water project funded by the USG in Iraq and one of the largest reconstruction projects in general.

This project was also conceived as a cost-sharing project with the KRG. The USG would fund the Ifraz WTP project, and the KRG would provide the electrical power to operate it, repair the leaks in the existing distribution network, provide a qualified staff to operate and maintain the facility after the project was turned over, and complete the expansion of the WTP.⁶⁷ In addition, this project provided the opportunity for the KRG to show its citizens that it could provide an essential service, such as potable water.

On May 8, 2010, SIGIR visited the Ifraz WTP.⁶⁸ The USG turned over the operation of the project to the KRG on July 20, 2006; therefore, at the time of SIGIR's site visit, the KRG had operated the facility for 45 months. During the course of the visit, SIGIR toured the facility and spoke with WTP personnel. SIGIR found the facility well maintained and clean.

In the administration building, the facility manager demonstrated the SCADA system. The SCADA system appeared to be functioning as it correctly indicated the out-of-service intake pump and filter cell and the clarifier that was down for routine maintenance. The SCADA system identified the WTP was operating at nearly 100% capacity by producing 5,856 m³/hour (Site Photo 5).

SIGIR observed laboratory technicians performing analysis of the water at various stages of the treatment process. The laboratory appeared to be clean and well stocked and to contain the necessary equipment for the various tests required to ensure treated water conformed to international standards. The laboratory technicians demonstrated the "Jar Test," which is used to determine the amount of aluminum sulfate required to be added to the influent to cause flocculation and settlement of particulate matter in the raw water. According to the technicians, this test is performed several times daily at the plant, which is desirable as these results not only improve the quality of finished water produced but also permit an economical usage of the aluminum sulfate; thereby reducing operating costs. In addition, the technicians use ovens for preparing samples and chemical test kits to determine the presence of harmful pathogens in the water. All tests are recorded in a log book. According to the laboratory reports, on the day of SIGIR's visit, the WTP was producing water between 0.8 and 0.9 NTU, which is within the design range of 0.5 to 1.0 NTU and well below the WHO standard of 5.0 NTU.

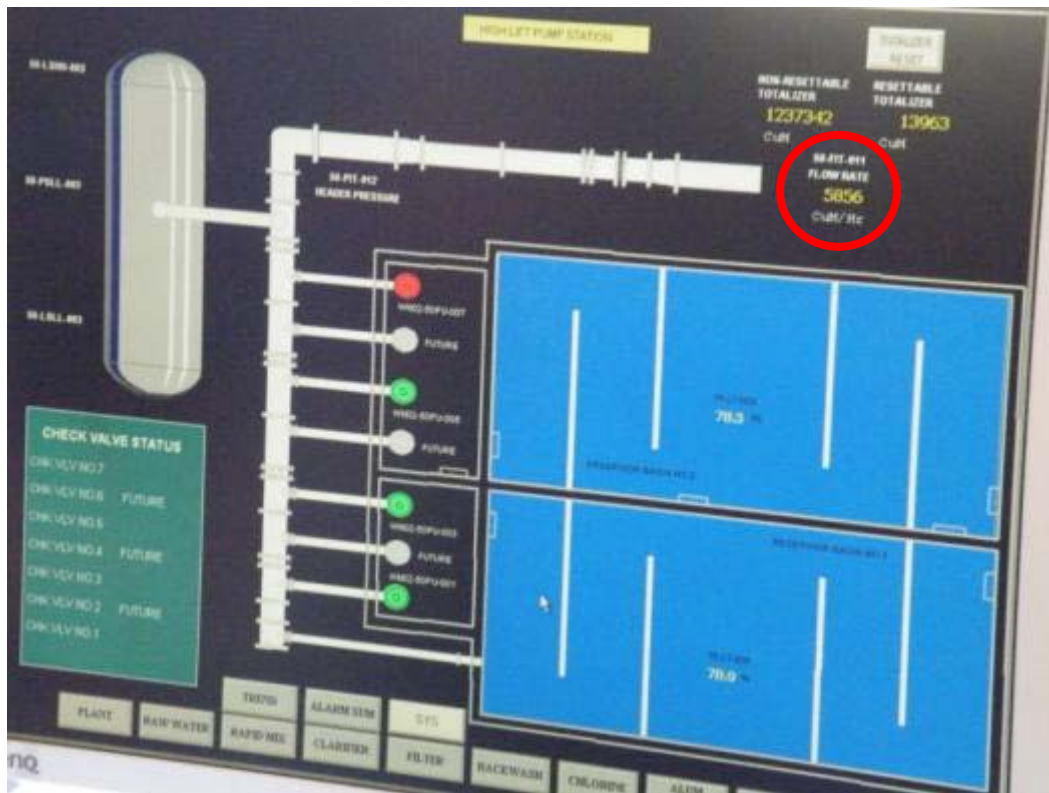
The Ifraz WTP is located on the east bank of the Greater Zab River. The raw water intake, a concrete structure built into the river bank, pumps water directly from the river. The raw water

⁶⁶ Prior to this project, Erbil had two existing WTPs – Ifraz I and Ifraz II. Ifraz I is a 38,000 m³/day WTP that has been in operation since 1969, and Ifraz II is a 690 m³/day WTP that has been in operation since 1983. The USG funded project is often referred to as Ifraz III. However, since a majority of the project file documentation refers to this project simply as "Ifraz WTP," SIGIR will refer to the project in this manner.

⁶⁷ The original objective of the project was to design and construct a 10,000 m³/hour WTP. The USG would fund the construction of a 6,000 m³/hour WTP and the KRG would be responsible for completing an expansion of the plant consisting of four additional clarifiers, high-service pumps, and additional equipment.

⁶⁸ SIGIR had not previously assessed or inspected the Ifraz WTP.

intake consists of concrete walls to direct the flow to the pumps, steel bar screens, four vertical turbine pumps, a pump manifold, and the required control systems and valves.



Site Photo 5. SCADA system indicating WTP producing 5,856m³/hour of finished water

Raw water from the intake is directed through a rapid mix basin where the aluminum sulfate is added and then sent to the clarifier units. The Ifrac WTP has six clarifiers; each clarifier consists of circular tanks with sloped floors. Mechanical scrapers rotate around the center of the tank directing settled solids to the center for pumping and disposal (Site Photo 6). Steel partitions inside the clarifiers separate zones and assist in the settling process.

SIGIR noticed one clarifier was out of service for routine maintenance. The remaining five clarifiers appeared to be functioning and adequately treating the raw water. SIGIR observed the fittings for the rotating mechanism of the scrapers had fresh grease, and it appeared WTP personnel were adequately maintaining the equipment.

After initial treatment by the clarifiers, the water flows to the rapid sand filters for final filtration. The sand filters consist of a rectangular structure, which has interior reinforced concrete walls to create 12 filter cells. Water enters the cell via a metal trough to prevent scour of the filter media. The water then filters through the media, which consists of a layer of filter sand and a layer of activated anthracite, and is collected at the base of the filter and sent to the storage tanks for distribution.

The filtered water is stored in a reservoir and pumped to the transmission main. The pump station consists of four vertical turbine pumps (three duty pumps and one standby) and the required controls and piping. At the time of SIGIR's visit, the three duty pumps were functioning and conveying water to the transmission main. According to the WTP's design, each pump is rated for 2,000 m³/hour; when operating at 100% capacity, the three duty pumps would

provide for a total of 6,000 m³/hour of finished water.⁶⁹ SIGIR observed the high-service pump control panel, which indicated a total output of 5,890 m³/hour.



Site Photo 6. Partial view of clarifier's mechanical scraper directly settled solids to the center for disposal

Construction and Operational Problems Resolved at the Ifraz WTP

According to the WTP manager, early on, a significant issue arose when the bar screen and pumps became clogged with vegetation from the river. To remedy this situation, the WTP maintenance personnel installed wire mesh livestock gates over the bar screen (Site Photo 7). The modified gates provide a smaller opening and restrict the passage of fibrous plant material that would bind the pump impellers, necessitating frequent shutdown and maintenance. The modified gates are attached to ropes and can be lifted and cleaned without requiring a shutdown of the intake pumps.



Site Photo 7. Bar screen with modifications

⁶⁹ It should be noted that even though the three duty pumps are designed to produce 6,000m³/hour, a small amount of water loss throughout the process is expected; therefore, the WTP will not produce exactly 6,000m³/hour.

In response to the failures in the pump station, WTP personnel instituted corrective action by replacing the damaged bend and adding additional support to the manifold. The additional support was provided by adding tie rods between pipe sections, pouring a concrete reaction block at the terminal end of the manifold (Site Photo 8) and constructing a steel brace at the elbow (Site Photo 9). SIGIR is concerned that the steel brace may be overloading the pump station building's reinforced concrete frame. Due to the relatively high pressure in the manifold and the large diameter of the pipes, a significant lateral force may be exerted on the reinforced concrete frame by the brace. SIGIR did notice multiple transverse cracks in the corner column of the building. Due to limited time on site and the scope of this evaluation, SIGIR did not determine if the cracking was due to structural overload.

The aluminum sulfate storage, mixing, and dosing building contains the equipment necessary to mix a concentrated solution of aluminum sulfate and supply a measured dose to the incoming raw water. The building consists of an upper storage level and a lower level with a tank and mixers for the solution and a pump chamber with dosing pumps. In addition, there is an opening in the floor of the upper level for adding aluminum sulfate to the mixing tanks. According to the WTP manager, the reinforced concrete at the edge of the upper opening had deteriorated due to inadequate coating used in the initial construction. This deterioration caused a delamination of the outer concrete surface, which fell into the tank. The pieces of concrete entered the dosing pumps and destroyed several of them. To resolve this situation, WTP personnel fabricated a stainless steel trough with covers and inset grates to fit into the opening. This prevents additional concrete from falling into the tank and inhibits further deterioration of the concrete.



Site Photo 8. Concrete reaction block



Site Photo 9. Steel brace connected to pump station building

In addition, the WTP manager stated the original pumps supplied with the project were not current technology and required frequent replacement. WTP personnel replaced four of the six dosing pumps damaged from the ingestion of concrete debris. The replacement pumps appeared to be diaphragm pumps suitable for caustic chemical transfer.

Remaining Construction and Operational Problems at the Ifraz WTP

During the tour of the facility, WTP personnel identified several construction-related issues. For example, the one clarifier's reinforced concrete tank walls exhibited cracking at several locations. Additional testing needs to be performed, including mapping of the cracks, monitoring for movement under various hydraulic levels in the tanks, and coring of the tank

wall, to determine if the cracking is either cosmetic in nature or indicative of potential failure of the tank.

The WTP manager also stated that one of the filter chambers, the reinforced concrete slab holding the filter media, had failed (Site Photo 10). This slab separates the filter media from the collection chamber below. Plastic nozzles penetrate the slab and provide a conduit for filtered water to be directed to the collection piping. In addition, backwash water is forced through the nozzles under pressure to periodically clean the filter. The WTP manager provided SIGIR with the contractor's final design drawings and associated field and equipment manuals. Based upon this documentation, the failure was attributed to structural inadequacy of the slab under the weight of the media filter and water. The WTP's documentation included design drawings for the filters but not the slab. Based upon the drawings, the slab was to be designed by the equipment supplier; however, according to the WTP manager, the equipment supplier did not provide this submittal.



Site Photo 10. Filter with media and failed slab removed

The vertical pumps are connected in parallel to the reservoir and discharge to a common manifold on the lower level of the pump station. The WTP manager stated several significant problems were encountered with the manifold from the commissioning of the plant. The most serious problems were the failure of a ductile iron bend and the continued displacement, both vertical and longitudinal, of the manifold. In addition, the seals failed at several of the pipe connections.

The interior walls of the pipe gallery are also the walls of the filter cells. The WTP manager pointed out cracking in some of the interior surfaces. The WTP manager suggested that the white substance seen at the crack locations (and throughout the pipe gallery) was aluminum sulfate, which is used in the WTP as a flocculating agent. While possible, in SIGIR's opinion, most of the flocculating agent should have been removed in the clarifiers prior to entering the rapid sand filter. It is also possible that the substance is efflorescence of the concrete, indicating exposure to chloride ions. This is a more likely scenario due the suspected salinity of the surface water being treated and the use of chlorine in the treatment process. This could indicate conditions that will accelerate deterioration of the filter structure, including corrosion of the reinforcing steel and dissolution of the aggregate.

Perceptions of Public Officials and the Population Generally Positive

Iraqi Public Officials

SIGIR held roundtable discussions with the Governor of Erbil and representatives from the Ministries of Water Resources (MoWR), MMPW, and Planning and Development Cooperation to discuss the impact of the Ifrac WTP. According to the Governor of Erbil, the people of Erbil are “very happy” with the “good projects” funded by the USG, specifically the Ifrac WTP. The governor thanked the USG for its generosity and expertise for funding and constructing the Ifrac WTP. Representatives from the MMPW and MoWR thanked the USG for the Ifrac WTP.

MoWR representatives stated that Iraq has problems sharing water with neighboring countries. For example, originally Turkey and Syria agreed to provide Iraq with 500 m³/second of water, but now Turkey and Syria are only providing between 200-250 m³/second. This causes problems for central and southern Iraq. To compensate for the decreased water from Turkey and Syria, the KRG digs wells for groundwater. However, an expanding number of wells are depleting the ground water. Previously, groundwater could be found at the depth of 100 m; now it is found between 400 and 500 m.

The governor and KRG representatives expressed concerns over water demand and usage. Specifically, the Governor of Erbil and KRG representatives stated that, due to its relative safety and rapidly expanding economy, Erbil is experiencing a tremendous growth in population.⁷⁰ Yet, the increasing population is placing a higher demand on water availability. MMPW representatives stated that between the Ifrac WTP, other existing WTPs, and ground wells, a majority of the current population has a primary source of drinking water; however, a segment of Erbil does not have a reliable source of water, which is unacceptable to the government.

In addition, MMPW representatives stated that the average per person water consumption is far too high. MMPW installed approximately 1,000 meters in each of the three KRG provinces to gauge water consumption. According to MMPW representatives, the initial results indicated water consumption at present is approximately 750 lppd. In addition to drinking, cooking, and hygiene activities, MMPW representatives found that water is being “wasted watering grass and washing cars.” To make water available to more people, the MMPW’s goal is to limit consumption by adopting the UN standard of 200 lppd. To accomplish this, the MMPW instituted a campaign of educating the population with literature and billboards about the benefits of water conservation. In addition, the MMPW purchased household meters in order to charge consumers for actual amount of water used. Prior to 1990, meters were in every house; however, over time, it turned into a tariff system. Households were simply charged the flat rate of 1,500 Iraqi dinar (approximately \$1.25) per month and businesses paid a monthly fee based on activity, regardless of consumption. In 2009, the revenues from customers were approximately 1.3 billion Iraqi dinar, which is less than 10% of the operational costs. According to MMPW representatives, it will take approximately two years to install the meters in every house in the KRG. Once installed, the MMPW will replace the tariff system with a consumption-based charge, which will increase revenues to pay for operation and maintenance costs and new projects. The MMPW plans to phase in price increases (resulting from the change from flat rate to actual consumption) in order to ease the burden on individual households. The MMPW is confident that the increased cost of water will quickly eliminate the current problem of overconsumption.

MoWR and MMPW representatives stated that the Ifrac WTP provided a great start in meeting Erbil’s water demand. The project’s original intent was a WTP capable of producing

⁷⁰ The Governor of Erbil estimated the annual population growth rate to be 3.1%.

6,000 m³/hour to provide drinking water to 600,000 of Erbil's population of 975,000.⁷¹ Part of the USG's contract for the Ifraz WTP included designs for future expansion to 10,000 m³/hour that would provide drinking water to approximately 400,000 additional Erbil residents. MMPW representatives stated that this expansion is essential to not only meeting current demand but also to prepare for future demand from an ever growing population. MMPW representatives noted some limitations with the Ifraz WTP. For example, one filter collapsed "due to poor design," and some spare parts for critical equipment are not easily purchased in Iraq.

With regard to the Ifraz WTP expansion and need for spare parts, neither the Governor of Erbil nor the KRG representatives requested additional funding from the USG. The governor stated the KRG received approximately \$13 billion in investment capital to modernize the entire province; almost 70% of the investment capital is from local sources, while the remainder is from Turkish investors. Consequently, the governor stated the KRG can fund and maintain its own projects. In September 2010, the KRG issued a request for qualification⁷² to contractors for two projects aimed at improving water supply infrastructure in the region. One project is the expansion of the Ifraz WTP (from 6,000 m³/hour to 10,000 m³/hour) and replacement of the old networks, totaling 350 km; while the second project consists of the construction and improvement of the Halabja integrated water supply system and Sulaymaniyah distribution network.

Local Population

SIGIR utilized focus group comments and flash polling data, collected in July and August 2010, from the local population served by the Ifraz WTP to gauge their perceptions of this project. A representative group of the local population from the cities receiving finished water from the Ifraz WTP was asked to comment on the quantity and quality of water received, reasons for shortfalls in water availability, efforts to improve water coverage, and the cost of water.

The Ifraz WTP became operational on July 20, 2006 to provide safe drinking water to a city suffering from the ill effects of years of poor-quality water and limited water availability. In addition, the WTP (and its expansion capability) provided supplementary drinking water for the anticipated growth for Erbil over the next 20 years. Prior to the Ifraz WTP, a significant portion of Erbil's city population was not connected to the general water network; yet, by 2007, the percentage dramatically dropped as this project provided potable water for 600,000 of Erbil's 975,000 residents (Figure 2).

Today, 88% of Erbil's city residents are either very or somewhat satisfied with the availability of water; with 93% stating the availability of water is better now than it was four years ago (2006), when the Ifraz WTP went online. The Ifraz WTP is identified by Erbil's residents as the primary reason for the increase in water availability. One Erbil resident stated that "after Ifraz [WTP], there are a lot of Mahalas in the city center that have increased their percentage of water." Equally as important, residents commented that the increased water availability is generally uninterrupted by power outages; a problem that has plagued the rest of the country. One Erbil resident stated, "Frankly, we rarely have interrupted water in our area—within the boundaries of [the] Ifraz plant."

In addition to increased water availability, 85% of Erbil's residents felt either very or somewhat satisfied with the quality of the available water. One resident from Erbil summed up the current situation by stating the "water is much better and is available better than four years ago." The

⁷¹ Erbil's total population in 2004, as estimated by the USG, was 975,000.

⁷² A request for qualifications is a document often distributed before a request for proposals in the project planning process. It is used to gather information from multiple companies (i.e., potential suppliers) to generate a pool of "pre-qualified" prospects. This step facilitates the proposal review and selection process.

perceived improvement in water quality is confirmed by the fact only 2% of Erbil’s residents stated members of their family have become sick from drinking tap water. As a result, 88% of Erbil’s residents use it as the primary source of drinking water.

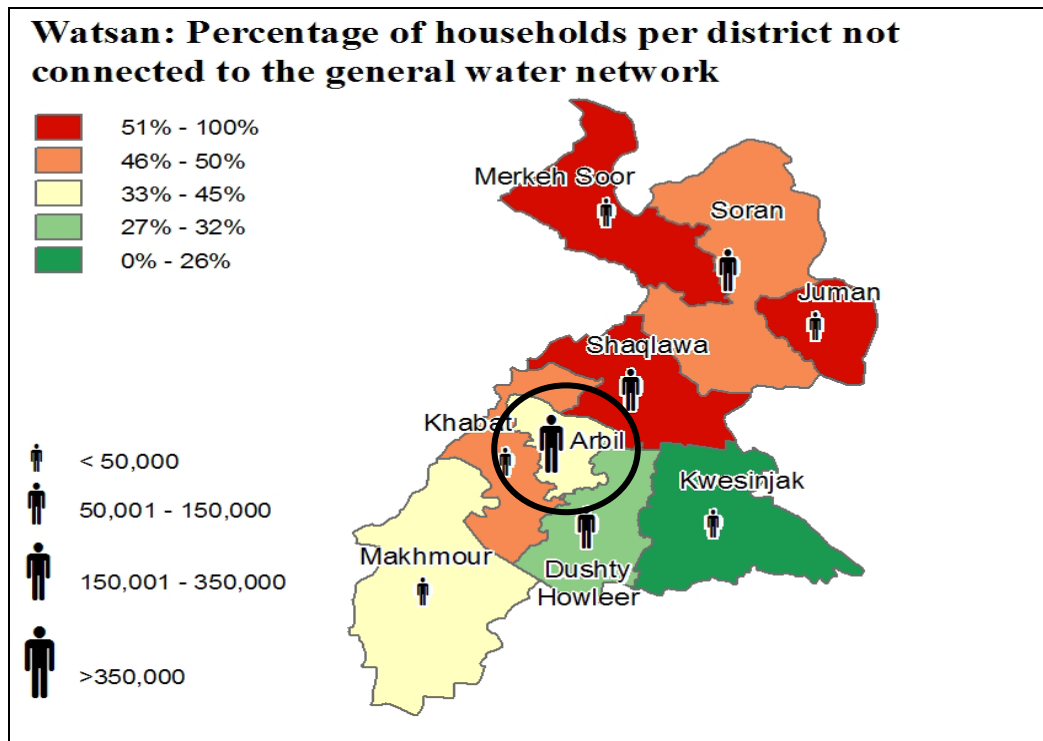


Figure 2. Percentage of population connected to the general water network prior to completion of the Ifraz water treatment system
(Courtesy of the UN Office for the Coordination of Humanitarian Affairs)

Erbil residents also identified several ancillary benefits from the Ifraz WTP. For example, even those residents not served by the Ifraz WTP stated that they believed the KRG was actively planning new projects to increase the availability of improved water. In addition, those served by the Ifraz WTP recognized potable water will eliminate many diseases, such as diarrhea and “help stabilize the health situation in the region.”

One unintended consequence of the Ifraz WTP appeared to be anger on the part of those residents not receiving the water. Due to funding limitations, the USG, from the beginning, recognized that 375,000 residents would not receive the benefits of improved water quantity and quality from this project. One resident living outside the Ifraz WTP’s coverage area stated that there are “some areas and neighborhoods that get water for 24 hours and there are other neighborhoods and other areas that do not have one hour of water supply.” In addition to the lack of available water, those residents outside of the Ifraz WTP’s service area stated they have to “buy bottled water for fear of disease and diarrhea.” One resident stated that she took her five year old son, who was suffering from severe diarrhea, to a hospital and the “doctors advised us not to drink the water in our area.”

Finally, 43% of Erbil’s residents believe the USG provided either significant or limited assistance in improving the area’s water supply. One Erbil resident identified the Ifraz WTP project as “one of the most important projects in the city that was established with American aid” and another wished to “thank the United States of America for having funded the project.” Even residents not served by the Ifraz WTP recognized its importance to the overall health and well

being of the city. One such resident stated that although “I do not benefit from the water from this project, I think we should thank America for constructing and financing the Ifraz project.”

Impact on Strategic Goals Difficult To Determine

In 2004, the USG found in the KRG a representative government based upon periodic elections. In addition, due to its support of the KRG during its infancy, the USG enjoyed overwhelming support from the KRG and its citizens for the 2003 Gulf War, especially the removal of Saddam Hussein. The Peshmerga, war tested by years of fighting against Saddam’s military forces, provided security for the KRG regions of Erbil, Dahuk, and Sulaymaniyah. Through the Ifraz WTP, the USG wanted to strengthen the KRG’s growing democracy by assisting its efforts to provide basic essential services. The assumption was that Erbil’s citizens would recognize and appreciate the efforts of both the USG and KRG in providing much needed drinking water.

Finally, the USG intended the Ifraz WTP to be the signature project in the north. While the secondary objectives of this project were to bring clean drinking water and improved health to the citizens of Erbil, the primary objectives were to capitalize on the KRG’s support for the USG and show the rest of Iraq the benefits possible from working with, not against, the USG.

Good Governance

For this project, the USG agreed to fund, construct, and commission the WTP, while the KRG agreed to provide a dedicated, reliable permanent power source, rehabilitate/replace the existing distribution network, and efficiently operate and sustain the project. SIGIR’s site visit, multiple discussions with U.S. reconstruction officials, Ifraz WTP staff, and KRG representatives revealed a well constructed facility efficiently operated and maintained.

Erbil, similar to the rest of Iraq, suffers from a critical shortage of reliable electrical power; however, the KRG provides a dedicated, uninterrupted electrical power line to operate the Ifraz WTP. As a result, the Ifraz WTP does not have to rely upon generator power to operate the WTP. During the site visit, SIGIR observed the WTP operating near full capacity. In addition, a capable and experienced staff kept the WTP in good working condition, with a clean laboratory and well maintained equipment. In addition, Ifraz WTP staff encountered several construction and operational issues, for which they identified and implemented corrective actions—for example, the previously mentioned raw water intake bar screen and pumps clogged with vegetation. To remedy this situation, the WTP maintenance personnel installed wire mesh livestock gates over the bar screen. The modified gates provided a smaller opening and restricted the passage of fibrous plant material that would bind the pump impellers, necessitating frequent shutdown and maintenance. The WTP staff also executed corrective fixes in the pump station and replaced four of the original six dosing pumps. Further, the KRG provides a sufficient amount of consumables to operate the WTP, such as fuel, aluminum sulfate, chlorine, and laboratory equipment.

KRG representatives repeatedly expressed the importance of this project to the overall health and well-being of Erbil residents; however, they also acknowledged that water is not available to all of Erbil’s expanding population. To rectify this problem, in September 2010, the KRG issued a request for qualifications to contractors for the expansion of the Ifraz WTP from 6,000 m³/hour to 10,000 m³/hour.⁷³ This expansion, when completed, will provide drinking water for approximately 400,000 additional Erbil residents.

Once awarded, the expansion of the Ifraz WTP will take approximately 12-18 months to complete; in the meantime, the KRG has taken proactive measures to conserve water. First, the

⁷³ The KRG also issued a request for qualifications from contractors for another water project in Sulaymaniyah.

KRG identified the UN standard of 200 lppd as a baseline for basic water needs. Next, the KRG purchased and installed 1,000 household meters to survey the per person amount of water consumed daily. When the results came in that the average person consumed three and a half times the UN standard, KRG officials recognized residents were utilizing water for more than basic needs. Their research determined residents were washing cars, watering grass and crops, and simply letting their hoses run. The KRG instituted a water conservation campaign, which appears to be working. One resident from Erbil stated that “we consume a lot of water and the citizen has a role in this water shortage. There is no rationing of water consumption; the women in the area sprinkle the street in front of the house with water.” The installation of meters in every household will be complete in two years; at which time, the KRG representatives are confident that charging residents for water actually consumed will alter their water usage habits. Over three quarters of Erbil residents stated they would be willing to pay more to improve water availability and quality. The household meters will provide a source of additional revenue for Erbil to fund its own projects and a higher percentage of its operational costs.

Erbil’s residents mentioned a problem experienced by Iraqis nationwide—corruption. Erbil residents believe that corruption “impedes solving the water crisis in the city”; yet a strong majority believes the provincial and local governments are providing “significant” assistance in improving Erbil’s water supply. Erbil residents’ confidence in its government to provide drinking water is a good indicator that the government is seen as legitimate.

Impact of the Ifraz WTP

In 2004, the KRG enjoyed distinct advantages over the remaining 15 provinces in Iraq, such as a representative government, security, and stability. Yet, Erbil’s water infrastructure, similar to the rest of Iraq, suffered from a lack of potable water production and poor state of the distribution network.

The CPA’s water sector goal was to increase potable water access to 90% of Iraqis; with the Ifraz WTP project adding 600,000 Erbil residents toward the achievement of this goal. However, the lack of household meters limits the ability to determine the number of residents served by this WTP or the amount of water consumed. In a recent pilot program, the KRG has installed 1,000 meters in the Erbil province; however, this was only to gauge current water-consumption data. The installation of meters throughout Erbil will take two years to accomplish; at that point, an accurate accounting of the number of residents served and individual consumption rates will be possible. An outcome measure of the project was the improvement in the health of Erbil residents by reducing the rate of water-borne illnesses and child mortality; yet, the CPA did not determine baseline health data to document either rate at the time the project was funded. Therefore, it is not possible to measure improvement in water and health outcomes.

Further, due to U.S. support of the KRG during the Saddam Hussein era, Erbil residents were more likely to view the USG in a positive light. However, the CPA did not establish a baseline of the Erbil residents’ feelings toward the USG and its reconstruction program prior to awarding the project. In addition, the CPA did not establish a method for measuring the Iraqis’ satisfaction with this specific project. SIGIR utilized recent focus group and flash polling data to determine the impact of this project. An overwhelming majority were satisfied with the quantity and quality of water from the WTP. In addition, 43% of the local population believes the USG provided assistance in improving the area’s water supply. Erbil residents identified the Ifraz WTP project as “one of the most important projects in the city that was established with American aid” and wished to “thank the United States of America for having funded the project.”

Conclusions

Objectives and Outcomes

The *National Strategy for Victory in Iraq* defined the long-term goal for Iraq as a nation that is “peaceful, united, stable, democratic, and secure.” A strategic objective to achieve this goal was to “Help Iraq Build Government Capacity and Provide Essential Services.” The CPA set forth a goal for the water sector of access to potable water by 90% of Iraqis.⁷⁴ In support of this, on April 21, 2004, the CPA awarded two separate task orders, in the amount of \$277 million and \$185 million, respectively, to construct the Nassiriya and Ifraz WTPs. SIGIR’s conclusions regarding the Nassiriya and Ifraz WTPs are presented in the following sections.

Nassiriya WTP

To provide potable water to five cities within the Thi-Qar province, the Nassiriya WTP was designed to produce 10,000 m³/hour of finished water with a maximum turbidity rate of 1.0 NTU. SIGIR visited the Nassiriya WTP on May 12, 2010, and found the plant producing water at 6,141 m³/hour or 61% of its design capability. The WTP manager claimed the plant operates 24 hours a day, seven days a week at 100% capacity during summer months and 60% capacity during winter months; however, SIGIR questions the accuracy of the statement. Discussions with WTP staff and local officials revealed that electrical power is available only for four to eight hours per day in Nassiriya. In addition, even when the power lines are energized, the lines are often overloaded with illegal taps from nearby neighbors. The end result is significant amount of time each day when electrical power is unavailable or degraded, which results in the WTP being operated via generator power. However, the WTP’s capacity, when operated solely on generator power, is limited to 20% of its design capability, or approximately 2,000 m³/hour.

In addition, the quality of finished water, while still within the WHO standard, was well outside the design maximum turbidity rates. Consequently, SIGIR is concerned the WTP is supplying water with potentially more pathogens to the distribution system and ultimately to the end users of Thi-Qar province. Further, since the turbidity rates are increasing, SIGIR questions the ability of the WTP staff to effectively operate the plant.

At the beginning of this project, the USG believed that as the GOI’s capabilities increased, there would be less reliance upon the USG. The USG attempted to build government capacity through this project by initially operating and sustaining the WTP while simultaneously training MMPW staff. Yet, since assuming control, the GOI has not adequately operated and maintained the WTP, enforced the removal of illegal taps, or provided sufficient consumables and spare parts. Instead the GOI continues to rely on the USG for financial and other support.

With regard to the CPA’s goal of providing potable water to 90% of Iraqis, the lack of household meters undermines the ability to determine the number of Thi-Qar residents served by this WTP or the amount of water consumed. GOI and local Iraqi public officials believe the WTP is producing 10,000 m³/hour and providing 900,000 Thi-Qar residents with between 350-450 lppd. However, SIGIR’s site visit determined the WTP was operating at 61%; while recent focus group and flash polling data revealed Thi-Qar residents are overwhelmingly dissatisfied with the quantity and quality of water from the WTP.

⁷⁴ “Rebuilding Iraq: U.S. Water and Sanitation Efforts Need Improved Measures for Assessing Impact and Sustained Resources for Maintaining Facilities,” U.S. Government Accountability Office, 7 September 2005, <<http://www.gao.gov/products/GAO-05-872>>.

In SIGIR's assessment, recent focus group and flash polling data of the target population indicates this project has not contributed to the security or stability of the Thi-Qar province. Specifically, the local population did not believe their individual communities benefited from improved essential service as a result of this project. This project did not meaningfully improve the quantity or quality of water they received or legitimize the GOI in their eyes. Three years of patience finally gave way to mounting frustration over the lack of electricity and safe drinking water, which ultimately resulted in street protests in June 2010.

In summary, due to the absence of baseline data to document conditions prior to USG funding of this project, SIGIR cannot conclusively determine a measurable quantitative impact of this project. However, based upon recent focus group and flash polling data of the target population, Thi-Qar residents hold an overwhelmingly negative view of this project, the GOI, and the USG. The majority of Thi-Qar residents are dissatisfied with the quantity and quality of water from the WTP. In addition, even though the USG expended more than \$277 million for this project, only 3% of the local population believed the USG provided even "limited assistance" in improving access to clean water in the area. Focus group participants in the Nassiriya area appeared to be largely unaware that the USG constructed the Nassiriya WTP. At the thought of the USG funding the Nassiriya WTP, nearly all participants indicated it did not change their feelings towards the USG. The words of one Thi-Qar woman reflected the view of many: "I do not have any love or favor toward them. Our [negative] views will not change toward the United States."

Ifraz WTP

To provide potable water to approximately 600,000 citizens of Erbil, the Ifraz WTP was designed to produce 6,000 m³/hour of finished water with a maximum turbidity rate of 1.0 NTU. SIGIR visited the Ifraz WTP on May 8, 2010, and found the plant producing finished water between 5,856 and 5,890 m³/hour with a turbidity rate between 0.8 and 0.9 NTU. The finished water production was near 100% capacity and the turbidity rates were within the design standard and significantly lower than the WHO standard of 5.0 NTU. Due to adequate resourcing by the KRG, the Ifraz WTP operates 24 hours a day, seven days a week with sufficient consumables, such as aluminum sulfate, chlorine, and laboratory equipment.

Ifraz WTP personnel identified several areas of concern regarding what they considered poor construction by the contractor. In some instances, such as the clogging of the intake bar screens, WTP personnel developed their own solutions (for example, filtering gates), while in other instances, such as the failure of one of the filter chambers, significant additional work is being undertaken to determine the cause and corrective action necessary.

At the beginning of this project, the USG believed that as the KRG's capabilities increased, there would be less reliance upon the USG. With regard to the Ifraz WTP, this is exactly the case. For the past 45 months, the KRG has efficiently operated and maintained the Ifraz WTP, consistently provided consumables, and identified and corrected deficiencies as they were encountered. In addition, the KRG has decided to expand the Ifraz WTP to full design capacity of 10,000 m³/hour, which should provide drinking water for an additional 400,000 residents not currently receiving water. The KRG has taken these actions independent of the USG, demonstrating its ability to plan for and meet the essential service needs of its people.

With regard to the CPA's goal for the water sector of providing potable water to 90% of Iraqis, the lack of household meters undermined the ability to determine the number of Erbil residents served by this WTP or the amount of water consumed. KRG and local public officials believe the WTP is producing 6,000 m³/hour and providing 600,000 Erbil residents with potable water. SIGIR's site visit determined the WTP was operating near full capacity, while recent focus group and flash polling data revealed at least 85% of Erbil residents are satisfied with the quantity and quality of water from the WTP.

In summary, due to the absence of baseline data to document conditions prior to USG funding of this project, SIGIR cannot conclusively determine a measurable quantitative impact of this project. However, based upon recent focus group and polling data of the target population, Erbil residents hold an overwhelmingly positive view of this project, the KRG, and the USG. The majority of Erbil residents are satisfied with the quantity and quality of water; 43% of the local population believes the USG provided assistance in improving the area's water supply. One Erbil resident identified the Ifraz WTP project as "one of the most important projects in the city that was established with American aid" and another wished to "thank the United States of America for having funded the project."

Impact on U.S. Strategic Goals

Poverty, underdevelopment, poor governance, and lack of services are often cited as drivers of violent extremism and potential sources of instability. From 2003 to 2005, the USG authored various strategies attempting to combat the growing levels of insecurity and instability throughout Iraq. The *National Strategy for Victory in Iraq* identified the USG goal of a "peaceful, united, stable, democratic, and secure" Iraq. This document, as well as the CPA Strategic Plan, recognized the importance of delivering essential services to the Iraqi people as one key to overcoming the country's instability. The COIN FM identified essential services as important to winning the "hearts and minds" of the local population and creating stability. Based on the available evidence, SIGIR could not conclude that the WTPs had a positive impact on the U.S. strategic goals in Iraq.

Comparison of the Nassiriya and Ifraz WTPs

GOI Operation and Sustainment of the Nassiriya WTP

In May 2010, SIGIR visited the Nassiriya WTP and held discussions with local public officials to determine if previously identified issues had been adequately addressed and the current operating status. At the time of the site visit, the GOI had operated the WTP for approximately 32 months. WTP staff and local public officials stated that the GOI still had not:

- Provided dedicated, reliable electrical power to the WTP
- Repaired all of the existing distribution network lines
- Provided adequate amount of consumables, such as fuel and chlorine
- Eliminated illegal taps in the distribution network

As a result, SIGIR found the Nassiriya WTP:

- Operating at approximately 61% capacity (6,141 m³/hour, compared with 10,000 m³/hour)
- Producing water with turbidity levels well above the design maximum rate of 1.0 NTU

Recent focus group and flash polling data indicated most Thi-Qar residents think there is an insufficient amount of water available and the water is poor quality.

According to Thi-Qar residents, the poor quality water has resulted in illnesses; 16% state members of their family have become sick from drinking tap water in the past 12 months. As a result, only 14% of Thi-Qar residents served by this project use it as a primary source of drinking water.

KRG Operation and Sustainment of the Ifraz WTP

In May 2010, SIGIR visited the Ifraz WTP and held discussions with local public officials to determine the current operating status. At the time of the site visit, the KRG had operated the WTP for approximately 45 months. According to WTP staff and local public officials, the KRG provides adequate:

- Dedicated electrical power source
- Consumables, such as fuel and chlorine

WTP staff identified several construction and operational problems; however, the staff took proactive approaches to resolving the issues. For example, similar to Garraf River (used for the Nassiriya WTP), the Greater Zab River contains a significant amount of vegetation, which clogged the raw water intake bar screen and pumps. To remedy this situation, the WTP maintenance personnel installed wire-mesh livestock gates over the bar screens. The modified gates are attached to ropes and can be lifted and cleaned without requiring a shutdown of the intake pumps.

As a result, SIGIR found the Ifraz WTP:

- Operating at near capacity (5,856 m³/hour, compared with 6,000 m³/hour)
- Producing water with turbidity levels within the design range of 0.5 to 1.0 NTU

Recent polling data indicated 88% of Erbil residents are either very or somewhat satisfied with the availability of potable water; 93% believe water availability is better now than it was in 2006 (prior to the Ifraz WTP). With regard to water quality, 85% of Erbil residents are either very or somewhat satisfied.

Only 2% of Erbil resident stated a family member had become sick drinking tap water, and 88% utilize it as their primary source of drinking water.

The KRG recognized from the beginning that approximately 375,000 residents would not be served by the Ifraz WTP. It has now raised the investment capital necessary to fund the expansion of the Ifraz WTP from 6,000 m³/hour to 10,000 m³/hour, which will provide potable water to approximately 400,000 residents. In September 2010, the KRG issued a request for qualifications from contractors to expand the existing WTP.

A summary comparison of key data on the Nassiriya and Ifraz WTPs is provided in Appendix B.

Recommendations

SIGIR recommends that the Department of State and other U.S. Government agencies involved in stabilization and reconstruction operations that include major infrastructure projects:

1. Design useful measures of effectiveness tied to U.S. strategic goals and objectives for each program or project undertaken.
2. Identify baseline data prior to program or project implementation in order to fully measure program effectiveness and assess project outcomes and impact.
3. Develop plans to analyze current data against baseline data to determine any adjustments to program or project plans and budgets, prior to completion and transfer to local authorities.

4. Provide for the necessary training of and sustainment by local authorities, in order to realize medium- and long-term strategic objectives.

Management Comments

SIGIR received a response to a draft of this report from the United States Forces-Iraq noting that its Engineering Capacity Development Office, in coordination with other appropriate staff of the United States Forces-Iraq, had reviewed a draft of this report and had no comments. The formal, written response from the United States Forces-Iraq is attached at Appendix D.

SIGIR is also working with State Department representatives who have indicated that they will shortly provide comments on the report and address the issues identified. The formal, written response from the State Department will be incorporated into this report at a later date.

Appendix A. Possible Justifications for Thi-Qar and Erbil Site Locations

Thi-Qar Province

Thi-Qar province is located in southern Iraq, sharing internal boundaries with the provinces of Missan, Muthanna, Qadissiya, and Wasit. Thi-Qar's geographical landscape is dominated by the Euphrates River basin and the vast Hammar Marsh, which at its peak, covered almost a third of the province prior to being drained by Saddam. Administratively, Thi-Qar province is divided into five districts: Nassiriya (the capital), Suq Al-Shoyokh, Chibayish, Shatra, and Rafai.⁷⁵ A 2006 study estimated the population of Thi-Qar at 1.63 million residents, with nearly 40% living in the capital city of Nassiriya.⁷⁶ The most densely populated cities and villages within the province are located along the two principal water courses.⁷⁷ Approximately 90% of the settlements throughout the province have less than 2,000 residents; a majority of which have a population less than 500 residents.⁷⁸

The northern part of Thi-Qar is crossed from north to south by the Garraf River, a tributary of the Tigris River that branches from the main river a few kilometers before the Kut barrage. The Garraf River supplies most of the water supply systems for the entire province; the districts of Rafai and Shatra stretch along its course, while the Nassiriya district is supplied by water from the Garraf River through the Sweet Water Canal. The Garraf River has a moderate saline content that usually does not exceed 700 milligram per liter (mg/l) of total dissolved solids (TDS). The remaining areas of Thi-Qar lack adequate water sources for potable usage. While the Euphrates River crosses these areas, the water would require desalination treatment as the TDS level is generally in the 1,500-2,000 mg/l range; however, no desalination units are currently available.⁷⁹

Thi-Qar utilizes approximately 523 km of transmission pipelines to convey water from its intake sources and approximately 1,085 km distribution network pipelines to provide water to its end users. Approximately 90% of both transmission and distribution network pipelines are less than 30 years old. As for the status, it was estimated that only 34% of the transmission lines and 44% of the distribution network lines were either "good" or "acceptable."⁸⁰

Thi-Qar has 106 WTPs in operation (20 conventional WTP, 78 compact units (pre-fabricated units of medium-small capacity), and 8 reverse osmosis plants); approximately 64% are medium-small sized, with a capacity less than 50 m³/hour (Figure 3).⁸¹

⁷⁵ "Thi-Qar Governorate Assessment Report," [United Nations High Commissioner for Refugees](#), October 2006.

⁷⁶ "New Eden Master Plan for Integrated Water Resources Management in the Marshlands Area, Volume I, Overview of present conditions and current use of the water in the marshlands area, Book 2 Water and sanitation, Annex F, Governorate of Thi Qar (33)," Iraqi Ministries of Environment, Water Resources, and Municipalities and Public Works, 2006.

⁷⁷ The Al Garraf River, which runs from north to south and the Euphrates River, which runs from west to east until it meets the Tigris River near Qurnah, creating the Shatt Al Arab.

⁷⁸ "New Eden Master Plan for Integrated Water Resources Management in the Marshlands Area, Volume I, Overview of present conditions and current use of the water in the marshlands area, Book 2 Water and sanitation, Annex F, Governorate of Thi Qar (33)," Iraqi Ministries of Environment, Water Resources, and Municipalities and Public Works, 2006.

⁷⁹ *Ibid.*

⁸⁰ *Ibid.*

⁸¹ *Ibid.*

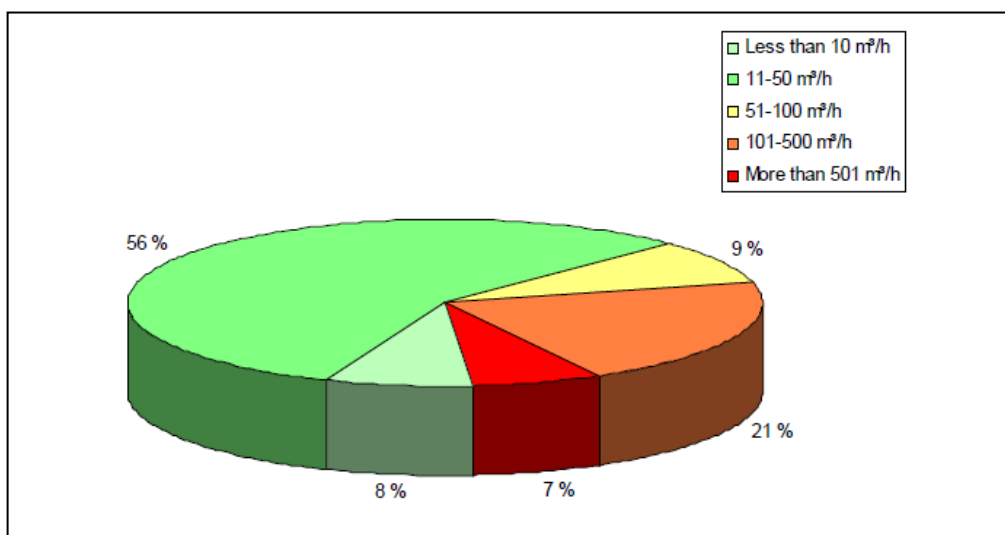


Figure 3. Types of WTPs in Thi-Qar province
(Courtesy of New Eden Master Plan 2006)

The overall capacity of the operating WTPs is 271,873m³/day; while the water demand is approximately 474,315m³/day. Consequently, Thi-Qar suffered from one of the worst water shortage deficits in Iraq (Figure 4).⁸²

Governorate	Supply (m ³ /day)	Demand (m ³ /day)	Deficit (m ³ /day)	Deficit (%)
Anbar	339,913	416,506	-76,593	-18%
Babil	226,962	462,482	-235,520	-51%
Baghdad	257,162	483,345	-226,183	-47%
Basrah	677,898	624,559	53,339	9%
Diyala	510,520	431,478	79,042	18%
Karbala	206,781	256,895	-50,113	-20%
Missan	192,577	252,676	-60,100	-24%
Muthanna	109,988	169,957	-59,969	-35%
Najaf	274,208	325,523	-51,315	-16%
Ninewa	621,198	829,592	-208,394	-25%
Qadissiyah	224,008	288,776	-64,769	-22%
Salah Al Din	260,559	342,840	-82,281	-24%
Tameem	261,559	289,186	-27,627	-10%
Thi Qar	271,873	474,315	-202,441	-43%
Wassit	225,214	306,968	-81,754	-27%
Total 15 governorates	4660,420	5955,098	-1294,678	-22%

Figure 4. Supply and demand data for 15 Iraqi provinces
(Courtesy of New Eden Master Plan 2006)

In addition to suffering from a severe water shortage deficit, the “treated” water that did reach Thi-Qar was often of poor quality, which resulted in increased cases of diarrhea and other water-borne diseases. According to UNICEF, children under five years old in Thi-Qar suffered from

⁸² “New Eden Master Plan for Integrated Water Resources Management in the Marshlands Area, Volume III, Implementation Plans, Book 7, Water and Sanitation assets,” Iraqi Ministries of Environment, Water Resources, and Municipalities and Public Works, 2006.

the second highest percentage of diarrhea cases for children less than 5 years of age⁸³ in Iraq (Figure 5).⁸⁴

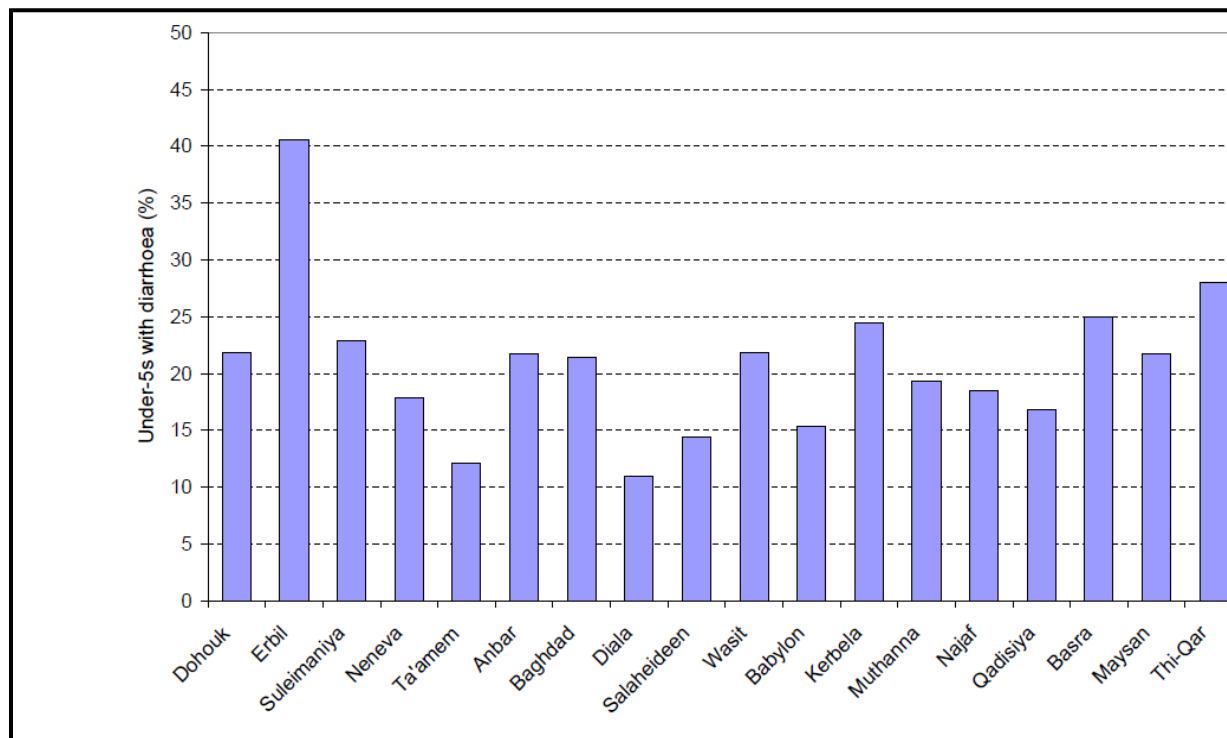


Figure 5. Percentage of diarrhea cases by province for children less than 5 years old (Courtesy of UNICEF)

Thi-Qar's Resentment toward the United States

Thi-Qar province is rich in historical sites; legend has it that it is the hometown of the Prophet Abraham. The name “Thi-Qar” honors the famous battle that took place in the pre-Islamic era between the Arabs in southern Iraq and Persians. To this day, residents of Thi-Qar are proud of its ancient history, particularly this battle. Just as important as its ancestry, the residents of Thi-Qar take pride of its long and prominent history of resistance. This province, especially the capital city of Nassiriya, was notorious during Saddam’s reign as one of the most troublesome spots for the Ba’ath government. Located near the ancient ruins of Ur, Nassiriya provided a safe haven for those who opposed the oppressive Saddam government; with the area’s vast marshes presenting a refuge for those who required hiding from Saddam’s forces. As a result, Thi-Qar, and Nassiriya in particular, bore the brunt of persecution by Saddam and his secret police and paramilitary forces. Mass graves, kidnappings and disappearances, and the draining of the marshes were just some of the punishments doled out by Saddam’s government. According to many locals, the hideouts in the Ahwar region still tell stories of the bravery and sacrifice of those who fought against Saddam.⁸⁵

During the 1991 Gulf War, the U.S. military penetrated Iraq up to Nassiriya, reaching the main road just outside the city. At the end of the war, Nassiriya’s Shia population attempted a revolt against Saddam’s government. The Shia believed the USG not only supported their efforts,⁸⁶ but would provide assistance if necessary. Saddam’s paramilitary forces violently crushed the

⁸³ UNICEF performed a survey and the results show the percentage of diarrhea cases within the two weeks prior to the survey.

⁸⁴ “Statistical Annex to Iraq Watching Brief – Graphs showing Governorate-level data,” *United Nations Children’s Fund*, December 2001.

⁸⁵ “Dhi Qar Strategic Plan 2007-2009, Development Strategy of the Dhi Qar Province,” Dhi Qar Provincial Council.

⁸⁶ “Iraq’s Opposition Movements CRS Report for Congress,” *Congressional Research Service, The Library of Congress*, 27 June 2000.

Shia revolt, killing thousands and generally destroying the city's infrastructure. The U.S. military did not engage in any fighting with Saddam's military during its purge of anyone associated with the rebellion.⁸⁷ This left a bitter taste in the mouths of Nassiriya's surviving Shia population, who believed the U.S. encouraged its rebellion but then turned its back on them when it failed to provide any assistance or protect them from Saddam's vengeance.⁸⁸ To many Nassiriyans, their lasting impression of the U.S. military (and government) is that they simply watched as Saddam's men slaughtered thousands of Shia rebels.⁸⁹

Erbil Province

In September 1961, Kurdish leader Mustafah Barzani revolted against Baghdad's authority.⁹⁰ Over the next decade, attacks and counterattacks were made. In 1970, secret negotiations between Barzani and Saddam Hussein led to the "March Manifesto," in which the Kurds agreed to stop their rebellion in exchange for the establishment of a Kurdish autonomous region in areas where the Kurds were a majority.⁹¹ However, the regime attempted to circumvent this agreement through the "Arabization" of the Kurdish areas.⁹² After years of fighting, on March 11, 1974, the Autonomous Region in the North of Iraq (ARNI), comprising the provinces of Erbil, Sulaymaniyah, and Dahuk, was established.⁹³

Prior to the 2003 Gulf War, the three main institutional frameworks for the water and environmental sanitation sector in Iraq were the following:

- Mayoralty of Baghdad, with the nine main municipalities of the capital district
- Iraq, excluding Baghdad mayoralty, comprising a total of 15 provinces
- ARNI, the autonomous administration of 3 northern provinces⁹⁴

The ARNI has a population of approximately 4 million, predominantly Kurds. This region is politically stable and has enjoyed de facto autonomy since 1991.⁹⁵

Erbil, the largest province in the ARNI, is located on the Turkish and Iranian borders. Erbil receives its water supply via surface and ground water via the Greater Zab River and deep wells, respectively.⁹⁶ The Greater Zab River is approximately 400 km long and originates in the mountains of the Kurdistan ridge at an altitude of 3,000m above sea level. The Greater Zab rises in Turkey near Lake Van⁹⁷ and joins the Tigris River south of Mosul.⁹⁸ Cutting through the numerous spurs of the Zagros Ridge, it changes direction three times. Its drainage basin covers approximately 40,300 km² and collects water from a large number of tributaries. The Greater Zab River and its tributaries are primarily fed by rainfall and snowmelt, which results in high

⁸⁷ Interviews with Thi-Qar Provincial Reconstruction Team members in Nassiriya, Iraq, May 2010.

⁸⁸ "Sadr's Political Role in Iraq." [Worldpress.org](http://www.worldpress.org/Mideast/3560.cfm). <http://www.worldpress.org/Mideast/3560.cfm>

⁸⁹ Interviews with Thi-Qar Provincial Reconstruction Team members in Nassiriya, Iraq, May 2010.

⁹⁰ "Iraq: U.S. Regime Change Efforts and Post-Saddam Governance, CRS Report for Congress," [Congressional Research Service, The Library of Congress](http://www.congress.gov/crsreports/misc/crs/2004/02/23/RS20040223.html), 23 February 2004.

⁹¹ "March Manifesto." [Encyclopedia Britannica](http://www.britannica.com/EBchecked/topic/926880/March-Manifesto). <<http://www.britannica.com/EBchecked/topic/926880/March-Manifesto>>.

⁹² "Genocide in Iraq: The Anfal Campaign Against the Kurds," [Human Rights Watch](http://www.hrw.org/reports/1993/iraqanfal/ANFALI.htm) report, 1993, <http://www.hrw.org/reports/1993/iraqanfal/ANFALI.htm>

⁹³ Carel DeRooy, "United Nations/World Bank Joint Iraq Needs Assessment – Water and Sanitation," October 2003, The World Bank, <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/05/06/000160016_20050506165619/Rendered/PDF/315410IQ0WATER01public1.pdf>.

⁹⁴ "Assessment Project of the Water and Sanitation Sector in Iraq," [SAFEGER](http://www.safegegate.com), January 2003.

⁹⁵ "Erbil City Water Network Management (Iraqi Kurdistan Region) Technical Proposal," [Qandil](http://www.qandil.org), May 2008.

⁹⁶ "Pre-Feasibility Study, Erbil City – Water Supply System," [Qandil](http://www.qandil.org), 7 January 2008.

⁹⁷ "New Eden Master Plan for Integrated Water Resources Management in the Marshlands Area, Volume I, Overview of Present Conditions and Current Use of the Water in the Marshlands Area, Book 1, Water Resources," Iraqi Ministries of Environment, Water Resources, and Municipalities and Public Works, September 2006 Edition.

⁹⁸ "Draft Report Physical Characteristics of Mesopotamian Marshlands of Southern Iraq," [The Iraq Foundation](http://www.theiraqfoundation.org), January 2003.

fluctuations throughout the year. The Battle of the Zab, which ended the Umayyad Caliphate, took place near a tributary of the Great Zab.⁹⁹

The use of groundwater varies considerably across Iraq. Several ARNI communities utilizing groundwater as the main source for the public water supply system; while many rural residences are completely reliant upon groundwater for their supply. Further, agricultural operations are partly or completely dependent upon groundwater for their water supply, especially in times of drought. The amount of groundwater in storage in each basin is dependent on the precipitation, recharge, and total extraction from all the wells. Erbil, with hundreds of wells of various sizes, is now under severe stress because of excessive groundwater abstraction over the years. Unsustainable groundwater abstraction rates have resulted in significant falls in the water table level with many wells going dry. Improper well drilling has also complicated matters by polluting the groundwater.¹⁰⁰

By 2003, Erbil's water supply system suffered from a lack of potable water production and the poor state of the water distribution network. In 2003, the GOI established a water shortage indicator with respect to an adequacy line as a threshold below which the available rate of water supply is not acceptable. The domestic supply rate is defined in order to assess the capacity of the public utilities to address the basic needs of the population. For the ARNI, the urban and rural adequacy lines were 150 and 50 liters per capita per day, respectively. The water shortage indicator is the ratio of the population for which water supply levels are below the adequacy line to the total served population. The urban and rural domestic water shortage rates for the ARNI were 99% and 100%, respectively.¹⁰¹ Consequently, the water supply is below the adequacy line for almost the entire population of the ARNI, which included the Erbil Governorate.

No doubt a contribution factor of the inadequate water supply was the overall poor state of the distribution networks. Erbil's city water network was designed and constructed in 1969 as a circular system. The water supply network, including the distribution and transmission lines, consisted of a total pipe length of approximately 1,830 km. Approximately 30% of the network was old and in such poor condition that immediate replacement was necessary. Reports estimated the number of pipe leakages at 10-15 per day. Frequent leaks in the distribution pipes lead to water loss, low pressure, and the potential for contamination of the drinking water. Some damage to the pipe lines occurred during excavations of new construction work in the area since no proper map of the water network pipelines existed. In addition, the original network design was inadequate because it required the use of pipes too narrow, which lead to increasing pressure drops and reduced flow. Some of the older pipes are made from asbestos cement and need to be replaced for that reason.¹⁰²

As a result of low pressure and pipe leakages, the quality of the water reaching the homes in Erbil was often poor, which resulted in increased cases of diarrhea and other water-borne illnesses. According to the KRG Ministry of Environment, 50% of Erbil's water was unfit for household consumption.¹⁰³ In addition, UNICEF reported that children under five years old in Erbil suffered from the highest percentage of diarrhea cases for children less than 5 years of age in Iraq (Figure 5).¹⁰⁴

⁹⁹ "Battle of the Great Zāb River." *Encyclopedia Britannica*. 2010. Encyclopedia Britannica Online. 19 Oct. 2010 <<http://www.britannica.com/EBchecked/topic/243926/Battle-of-the-Great-Zab-River>>.

¹⁰⁰ Ali, Salahuddin, "Geology and Hydrogeology of Sharazoor – Piramagroon Bain in Sulaimani Area, Northeastern Iraq," *University of Belgrade Faculty of Mining and Geology*, Belgrade, 2007.

¹⁰¹ "Assessment Project of the Water and Sanitation Sector in Iraq," *SAFEGE*, January 2003.

¹⁰² "Erbil City Water Network Management (Iraqi Kurdistan Region) Technical Proposal," *Qandil*, May 2008.

¹⁰³ "Governorate Assessment Report Erbil Governorate," *United Nations High Commissioner for Refugees*, September 2007.

¹⁰⁴ "Statistical Annex to Iraq Watching Brief – Graphs showing Governorate-level data," *United Nations Children's Fund*, December 2001.

Further, while the rest of Iraq experienced escalating violence in 2004, the ARNI, and Erbil Governorate in particular, enjoyed a relative calm. In addition, Erbil did not endure the widespread looting of infrastructure and government headquarters seen throughout the remainder of the country. As a result, government estimates predicted a steady increase of 3% population growth for Erbil, reaching 2.9 million by 2025.¹⁰⁵ Government estimates also indicated an overall per capita demand of between 360 and 390 liters per day (lpd), which would indicate an additional total demand of 160,216m³/day by 2025.¹⁰⁶ Erbil's water production could not meet the current demand by its residents, let alone absorb the additional demand that will continue to increase with the projected growth.

¹⁰⁵ "Agriculture Reconstruction and Development Program for Iraq, Strategy for Water and Land Resources in Iraq, Phase 1 Project Completion Report, Volume 3 – Annexes 1 – 15," [USAID](#), October 2006.

¹⁰⁶ *Ibid.*

Appendix B. Summary Comparison of the Nassiriya and Ifraz Water Treatment Plants

Current operating status:

	Nassiriya WTP	Ifraz WTP
Actual output as a percentage of construction capacity (cm/hour)	61%	98%
Turbidity levels of produced water (NTUs)	Higher than maximum design	Lower than maximum design
Permanent, reliable electrical power source available to WTP	No	Yes
Adequate amount of consumables provided by GOI/KRG	No	Yes
Number of people intended to be served by WTP	550,000	600,000
Turnover date to GOI/KRG	September 2007	July 2006
Total Project Cost	\$277 million	\$185 million

Perceptions of the local population:

	Nassiriya WTP	Ifraz WTP
Percentage who are satisfied with water availability	23%	88%
Percentage who are satisfied with water quality	5%	85%
Family member sick from drinking WTP water in past 12 months	16%	2%
Percentage of population utilizing WTP water as primary source	14%	88%
Percentage of population who believe USG provided significant or limited assistance in improving the area's water supply	3%	43%
Predominant focus group sentiment of local population towards the USG as a result of WTP project	<i>“Our [negative] view will not change towards the United States.”</i>	<i>“Proof of their [USG's] attention to people's lives and we would like to thank them for what they did for us.”</i>

Appendix C. Acronyms

ARNI	Autonomous Region in the North of Iraq
BPS	Booster Pump Station
COIN	Counterinsurgency
CPA	Coalition Provisional Authority
CU	Compact Unit
FM	Field Manual
GDP	Gross Domestic Product
GOI	Government of Iraq
HN	Host Nation
ISPO	Iraq Strategic Partnership Office
kg	kilogram
km	Kilometer
km ²	Square Kilometer
km ³	Cubic Kilometer
KRG	Kurdistan Regional Government
l	Liter
lb	Pound
lpd	liter per day
lppd	Liter per Person per Day
m	meter
m ³	Cubic Meter
mg/l	milligram per liter
mm	millimeter
MMPW	Ministry of Municipalities, Public Works, and Tourism
MoE	Minister of Electricity
MoWR	Ministry of Water Resources
NTU	Nephelometric Turbidity Units
OFFP	Oil for Food Program
ppd	Per person per day
SCADA	Supervisory Control and Data Acquisition
SIGIR	Special Inspector General for Iraq Reconstruction
TDS	Total Dissolved Solids
UN	United Nations
UNICEF	United Nations Children's Fund
USG	U.S. Government
WHO	World Health Organization
WTP	Water Treatment Plant

Appendix D. Comments from United States Forces-Iraq



REPLY TO
ATTENTION OF

**HEADQUARTERS
UNITED STATES FORCE-IRAQ
BAGHDAD, IRAQ
APO AE 09342**

USF-I J7

23 Oct 2010

MEMORANDUM FOR CENTCOM RFI Manager

SUBJECT: SIGIR CT-1012-001 Draft Report EV-10-002, "Review of Major U.S. Government Infrastructure Projects in Iraq: Nassriya and Ifaz Water Treatment Plants"

1. The J7 Engineering Capacity Development office in coordination with the appropriate USF-I staff completed a review of the subject document and have no comments.
2. POC is the undersign at Janice.dombi@s-iraq.centcom.smil.mil or (SVOIP) 243-4642.

A handwritten signature in black ink, appearing to read "Janice L. Dombi".

JANICE L. DOMBI
COL. EN
Director Engineer Capacity Development
USF-I J7

Appendix E. Report Distribution

Department of State

Secretary of State

Senior Advisor to the Secretary and Coordinator for Iraq

Director of U.S. Foreign Assistance/Administrator, U.S. Agency for International Development

Director, Office of Iraq Reconstruction

Assistant Secretary for Resource Management/Chief Financial Officer, Bureau of Resource Management

U.S. Ambassador to Iraq

Director, Iraq Transition Assistance Office

Mission Director-Iraq, U.S. Agency for International Development

Inspector General, Department of State

Department of Defense

Secretary of Defense

Deputy Secretary of Defense

Under Secretary of Defense (Comptroller)/Chief Financial Officer

Deputy Chief Financial Officer

Deputy Comptroller (Program/Budget)

Deputy Assistant Secretary of Defense-Middle East, Office of Policy/International Security Affairs

Inspector General, Department of Defense

Director, Defense Contract Audit Agency

Director, Defense Finance and Accounting Service

Director, Defense Contract Management Agency

Department of the Army

Assistant Secretary of the Army for Acquisition, Logistics, and Technology

Principal Deputy to the Assistant Secretary of the Army for Acquisition, Logistics, and Technology

Deputy Assistant Secretary of the Army (Policy and Procurement)

Commanding General, Joint Contracting Command-Iraq/Afghanistan

Assistant Secretary of the Army for Financial Management and Comptroller

Chief of Engineers and Commander, U.S. Army Corps of Engineers

Commanding General, Gulf Region Division

Chief Financial Officer, U.S. Army Corps of Engineers

Auditor General of the Army

U.S. Central Command

Commanding General, Multi-National Force-Iraq
Commanding General, Multi-National Corps-Iraq
Commanding General, Multi-National Security Transition Command-Iraq
Commander, Joint Area Support Group-Central

Other Federal Government Organizations

Director, Office of Management and Budget
Comptroller General of the United States
Inspector General, Department of the Treasury
Inspector General, Department of Commerce
Inspector General, Department of Health and Human Services
Inspector General, U.S. Agency for International Development
President, Overseas Private Investment Corporation
President, U.S. Institute of Peace

Congressional Committees

U.S. Senate

Senate Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Foreign Relations
Senate Committee on Homeland Security and Governmental Affairs

U.S. House of Representatives

House Committee on Appropriations
House Committee on Armed Services
House Committee on Foreign Affairs
House Committee on Oversight and Government Reform

Appendix F. SIGIR Evaluation Team Members

This report was prepared under the direction of Philip J. Mistretta, Assistant Inspector General for Evaluations, Office of the Special Inspector General for Iraq Reconstruction. The principal staff members who contributed to the report were:

Angelina Johnston

Brian Flynn

Kevin O'Connor

Shawn Sassaman, P.E.